Knowledge Integration Processes and Dynamics: An Empirical Study of Two Cross-functional Programme Teams

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ABSTRACT

This thesis critically reviews and evaluates theories of organisational knowledge and knowledge-related activities. Specifically, it assesses and synthesises relevant theories and thoughts to develop a conceptual model of the knowledge integration process. Empirical evidence, collected from two organisations- Boots The Chemists and NatWest Global Financial Markets is also exploited as a means of building a grounded theory of knowledge integration

This theory explains the processes of knowledge integration within the context of cross-functional project teams. It also considers the general factors that influence these processes, as well as the dynamic interrelationships between the proposed processes. The theory provides a framework not only for future research to systematically examine and test knowledge integration processes within different organisations, but also allows management to continuously anticipate knowledge integration activities within their own organisations.

Based on a social construction perspective, this thesis demonstrates that knowledge integration is more than merely the representation of intellectual activities underlying the planning, redesign and implementation stages of a cross-functional programme. It also argues that cross-functional knowledge integration is a continuous process in which programme participants establish emotional alignment through social interaction.

This research contributes to studies of organisational knowledge and knowledge-related activities by providing an explorative account that synthesises existing literature with empirical evidence. Secondly, this research contributes to the theoretical development of knowledge integration by focusing on its processes rather than just its outcomes and implications which have been the main concern of other researchers. Finally, the development of a cross-functional knowledge integration theory contributes to the consolidation of the intellectual and emotional dimensions of knowledge-related activities that have in the past been treated in isolation.

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Abbreviations

BP Amoco	British Petroleum Amoco
BPR	Business Process Redesign
BT	British Telecommunications
BTC	Boots The Chemists
DTI	Department of Trade and Industry
FTSE	Financial Times Stock Exchange
GFM	Global Financial Markets
GMP	GFM Millennium Programme
IBM	International Business Machine
ICT	Information Communication Technology
IMRO	Investment Management Regulatory Organisation
IT	Information Technology
MIRA	Motor Industry Research Association
NatWest	National Westminster Bank
NGC	National Grid Company
SB	SmithKline Beecham

Declaration

This thesis is presented in accordance with the regulations for the degree of doctor of philosophy (Ph.D.). The work described is entirely original and my own, unless otherwise indicated. None of the material contained hereafter has been submitted for a degree at any other university. The interpretations in this thesis are the sole responsibility of the author, and do not in any way represent the views of the case companies or Warwick Business School.

The following papers based on the findings in this thesis have already been published

Book Chapter

Huang, J. and Antonacopoulou, E. (1999), 'How an oil giant learns: A case study of British Petroleum', in W. Baets, edited 'A collection of essays on complexity and management', London: Word Scientific.

Conference Papers

Huang, J. C., Newell, S. and Pan, S. L. (2000), 'Knowledge integration: Learning from millennium bug experience: A case study of Natwest Global Financial Markets', European Conference on Information Systems (ECIS 2000), Presented in July 2000, Vienna, Austria.

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Chapter One: Introduction

1.1 Research Objectives and Significance

The growing interest in the issue of organisational knowledge has been reflected in the increased academic attention, as well as the number of organisations that have begun to pay particular attention to the way they manage their knowledge. Despite the fact that the value of knowledge to organisations has long been recognised by management scholars (e.g. Bell 1973; Drucker 1968), it is only recently that knowledge within the organisational context has been studied in its own right. The diversity in research foci and efforts has extended the understanding of knowledge from simply what people know, to what people do (Blackler 1995; Blackler, Crump and McDonald 2000; Gherardi 2000; Grant 1996). This is evident in numerous management studies that emphasise how knowledge can be created (Nonaka and Takeuchi 1995), shared (Hansen 1999; Pan and Scarbrough 1999), acquired (Huber 1991), transferred (Lam 1997; Wathne, Roos and von Krogh 1996) and managed (Hedlund 1994; Quintas, Lefrere and Jones 1997). The present study categorises the above type of research into studies of knowledge-related activities.

In synthesising all efforts of researching knowledge-related activities and organisations' competitiveness, Grant (1996) concludes that 'the primary role of the firm, and the essence of organisational capability, is the integration of knowledge' (p: 375). The concept of knowledge integration is also addressed and examined by other studies, for example in relation to aspects of collaboration (Lawrence and Lorsch 1967), process

development (Pisano 1994) and product development (Pinto and Pinto 1990). Despite the abundant research efforts, however both within the intra- and inter-organisational contexts, it is manifest that previous studies placed emphasis primarily upon the outcome, importance and implications of knowledge integration. There are relatively few previous studies that seek to unveil and theorise the underlying processes of knowledge integration (Hauptman and Hirji 1999), in particular within the context of cross-functional project teams. Inspired by the need for further theoretical development, this thesis aims to fill this gap by building a grounded theory that is able to depict the processes of knowledge integration, as well as the dynamic interrelationships between those processes. The context of cross-functional project teams reflects the primary emphasis of the study that is to focus on knowledge integration processes and dynamics at the team and group levels, rather than at the organisational or inter-organisational levels. Also, this explains why some important concepts, such as the importance of knowledge to a firm's growth (Penrose 1959) and cross-organisational technology diffusion (Attewell 1996; Newell, Swan, Newell and Robertson 1999), are not incorporated into the study.

1.2 Synopsis of Current Literature and Research Gaps

In terms of the nature of organisational knowledge, past findings suggest that knowledge is not merely something that is abstract, centralised and detached from its context (Star 1989). Instead, organisational knowledge is context dependent (Nonaka and Konno 1998), dispersed (Tsoukas 1994), practice-based (Cohen and Bacdayan 1994), culture-specific (Sackmann 1991) and multi-faceted (Collins 1993). Drawing on an examination

of the nature of organisational knowledge, studies developing knowledge typologies propose numerous categorisations in conceptualising the distinctiveness of organisational knowledge. Some examples of knowledge typologies include the tacit and explicit dimensions advocated by Polanyi (1958), Sanchez and Heene's (1997) know-what, know-how and know-why, as well as public and private knowledge by Matusik and Hill (1998). Stemming from the development of such knowledge typologies, further research stresses activities in which knowledge is embedded, as reflected in the concept of knowing (Blackler 1995; Blackler Crump and McDonald 2000; Gherardi 2000).

Synthesising various knowledge typologies with the concept of knowing, knowledge-related activities are summarised in this thesis into six categories, namely knowing-what, knowing-who, knowing-how, knowing-why, knowing-where and knowing-when. For instance, the study of social capital in relation to knowledge creation (Nahapiet and Ghoshal 1998) is an example that anticipates how knowing-who and knowing-where facilitate the process of knowing-how. Additionally, the study of collective learning from the aspect of organisational routines (Cyert and March 1963) demonstrates an equal emphasis on the issues of knowing-what and knowing-why. In comparison to other types of knowing, the concept of knowing-when is less developed and articulated. The need for theoretical development in explaining how organisations prioritise their knowledge-related activities is clearly evident.

The current literature in the area of knowledge-related activities also provides a vital foundation to explore and anticipate the dynamics of cross-functional knowledge integration. For instance, theories of knowledge creation indicate the importance of

externalising knowledge that is often tacit and embedded (Nonaka and Takeuchi 1995). Also, the creation of new organisational knowledge lies in the process of combining existing knowledge, regardless of whether it is tacit or explicit (Nahapiet and Ghoshal 1998; Nonaka and Takeuchi 1995). The study of knowledge sharing suggests not only the importance of understanding the interplay between technical and social issues (Pan and Scarbrough 1999), but also the need for overcoming boundaries created by cultural differences (Lam 1997). Collective learning research has enlarged our understanding of how knowledge can be acquired (Huber 1991), utilised (Arrow 1962), and discarded (Hedberg 1982) as a means of enhancing organisational renewal (Jones and Hendry 1994). Clearly, from the above examples, the study and conceptualisation of knowledge integration can not be isolated from other knowledge-related activities.

Additionally, even though concepts such as paradigm (Kuhn 1970) and organisational memory (Walsh and Ungson 1991) are often quoted in the research of knowledge-related activities and organisational knowledge, there are relatively few accounts that explain their significance and influence in relation to knowledge-related activities. In particular, previous accounts of knowledge integration have largely failed to take into account paradigm and organisational memory as part of their inquiries. An important contribution of this thesis then is the way it incorporates the concepts of paradigm and organisational memory as a means of exploring the processes of cross-functional knowledge integration.

Although the advantages of using cross-functional project teams are strongly promoted (e.g. Denison, *et al.* 1996; Lichtenstein, *et al.* 1997), there is comparatively little

empirical evidence available to depict the dynamics of knowledge integration within such a specific context, especially in relation to the use of virtual teams in an organisation. Such virtual teams often employ information communication technology (ICT) to overcome geographic constraints (e.g. Ciborra and Suetens 1996; Jarvenpaa, Knoll and Leidner 1998) or cut down travelling cost (e.g. Wilson 1994). Our understanding about such practice is still limited primarily to such advantages. Difficulties and problems encountered by virtual teams in terms of encouraging knowledge sharing (Ciborra and Patriotta 1996) and developing emotional attachment (Lembke and Wilson 1998) and trust (Jarvenpaa, *et al.* 1998) require much more investigation. Stemming from such theoretical underdevelopment, this study incorporates cross-functional virtual teams as the main context for exploring knowledge integration processes.

Based on the notion of Berger and Luckmann (1967) that reality is constructed through the social interaction of actors, it is clear that such a reality can only be understood and analysed through its evolution. Further thoughts and ideas added to the social construction perspective, such as SCOT (Grint and Woolgar 1997; Pinch and Bijker 1987) and actor-network theory (Latour 1987), all share the view that the essence of studying any social process lies in the understanding of the dynamics of social interaction. Such perspectives provide an adequate philosophical lens with which to anticipate and theorise the processes of cross-functional knowledge integration. Synthesising the above theories, thoughts and perspectives, three research questions are proposed and answered in this thesis, namely:

- **What are the processes of knowledge integration within the context of cross-functional project teams?**
- **What are the issues that influence these cross-functional knowledge integration processes?**
- **What are the dynamic interrelationships between those knowledge integration processes?**

1.3 Research Methodology and Design

Empirical evidence is necessary for the above research questions to be answered, and to achieve the research objective of building a grounded theory (Glaser and Strauss 1967; Strauss and Corbin 1990) that is able to depict the phenomenon of cross-functional knowledge integration. Based on the seminal work of Glaser and Strauss (1967), Yin (1984) and Miles and Huberman (1984), Eisenhardt's (1989) generative account of using case studies for theory building provides a useful guideline for shaping the research design. The case study research design adopted in this thesis is based on the rationale of flexibility in using multiple data collection methods, as well as the ability to articulate insightful stories embedded within the chosen social context (Van Maanen 1979). The development of a case study protocol helped not only to clarify necessary procedures, but also to enhance the reliability of the study (Stake 1995; Yin 1984). A pilot case study conducted in BP Amoco enabled the researcher to acquire first hand research experience, improve the research design and provide an excellent example of how to develop a relationship of mutual trust with the research subjects.

Based on the concept of theoretical sampling (Glaser and Strauss 1967), two research sites were selected based on the criteria of project scope, duration and the geographic dispersion of participants. Such selection also helped to accommodate both theoretical similarities and differences (Orlikowski 1993). Despite the fact that gaining access to research sites appeared to be more difficult and problematic than anticipated, valuable lessons were gained and are illustrated in Chapters Three and Seven. The two case studies finally conducted were in Boots The Chemists (Business Process Redesign Programme) and National Westminster Bank Global Financial Markets (GFM Millennium Programme). The data collected through interviews, on-site observation and documentation were analysed systematically based on the concepts of open, axial and selective coding (Strauss and Corbin 1990), as well as the technique of matrix display proposed by Miles and Huberman (1994).

1.4 Research Findings

Four distinctive but interrelated knowledge integration processes were identified from the data. The term 'boundary penetrating' is used to refer to the process by which team members break through various task-related and socio-emotional (Benne and Sheats 1948) boundaries to acquire the information and knowledge needed for a programme. The complexity and multi-dimensional and –faceted nature of boundaries are illustrated and conceptualised. This shows clearly why boundary penetrating is so problematic but also critical for understanding processes of cross-functional knowledge integration. The second process of cross-functional knowledge integration is termed 'priority maintaining' and represents the process by which programme awareness is constantly

reinforced and priority is continuously sustained through competition with other programmes and initiatives. The third process is called 'paradigm expanding' and refers to the process by which consensus is developed from different theoretical and methodological rules, instruments and standards practised by the programme participants. The final process is termed 'organisational memory refining'. The concept of organisational memory refining is used here to refer to the process through which organisational memory is continuously re-examined, challenged, modified, and redefined through the social interaction of programme participants during various stages of the cross-functional programme.

Evidence abstracted from the analysis suggests that from a task-related perspective the use of incentives, the selection of programme participants to ensure knowledge redundancy (Nonaka 1990) and the presence of external forces are the three main issues that influence the process of boundary penetrating. On the other hand, from the socio-emotional perspective, the availability of social networks (Burt 1992; Nahapiet and Ghoshal 1998) and the development of trust (Newell and Swan 2000) between participants were found to be paramount for penetrating the various different types of boundaries identified from the two cases. From an intellectual dimension, the evidence indicates that programme progress and information sharing are crucial to the process of priority maintaining. In contrast, from the emotional aspect, sharing programme ownership and the reconfiguration of social networks are critically essential for the process of priority maintaining. Perspective taking (Boland and Tenkasi 1995; Sessa 1996) and mutual learning (March 1991) are identified as two main issues that influence the process of paradigm expanding. Finally, the management of group diversity (Hauser

1998), transforming information into knowledge, and applying knowledge into day-to-day organisational practices and routines are found to be vital for refining organisational memory.

Despite the fact that the above four processes are analytically separated, they are in fact interconnected and mutually reinforced. In terms of the dynamic interrelationships, it is found that to penetrate three different types of boundary, either task-related or socio-emotional, requires aligning the programme participants and the stakeholders intellectually and emotionally. This points to a link between boundary penetrating and priority maintaining through the achievement of intellectual and emotional buy-in. Group diversity as a source of paradigmatic differences also creates boundaries that need to be penetrated. This demonstrates the interdependence between the processes of boundary penetrating and paradigm expanding. The management of group diversity was found to be crucial for the process of organisational memory refining, suggesting a link between the processes of boundary penetrating and paradigm expanding. The interrelationships between the process of priority maintaining and the other three are reflected in the importance of maintaining programme priority as a means of ensuring the continuity of cross-functional knowledge integration activities.

1.5 Theoretical, Methodological and Managerial Contributions and Implications

Derived from the synergistic nature of this study, one of the major theoretical contributions is to provide an account of the phenomenon of cross-functional knowledge

integration. Systematic efforts in identifying various types of boundary and the elaboration of boundary penetrating point out the incompleteness of perceiving knowledge sharing as a merely psychological issue influenced by individuals' willingness. The concept of priority maintaining raises the importance of resources in energising knowledge-related activities that are commonly neglected in the current literature. The discussion of priority maintaining further portrays resource allocation as not simply a decision based on an objective measurement of pros and cons. Resource allocation is an ongoing socialising process between organisational members and is largely influenced by the landscape of social networks.

Another theoretical contribution lies in the exploration of the knowledge integration concept within the context of cross-functional teams, in particular where participants are geographically dispersed. Findings generated in this thesis not only extend the concept of 'community of practice' (Brown and Duguid 1991; Wenger and Snyder 2000) by adding the virtual dimension, but also enlarge the concept of situated learning (Lave and Wenger 1991) by inputting different phenomena to the process of 'peripheral legitimate participation'.

The third theoretical contribution is to incorporate a social construction perspective into the study of knowledge integration. Stemming from the social construction perspective (Berger and Luckmann 1967), four interrelated processes elaborated in this study suggest that cross-functional knowledge integration cannot be anticipated merely from the intellectual aspect. Instead, the emphasis should be placed upon the interplay

between the intellectual and emotional elements underlying the phenomenon of cross-functional knowledge integration.

In addition to the theoretical implications, the four knowledge integration processes elaborated above have methodological implications, as they can be applied as a guideline for data collection. Firstly, the concept of boundary penetrating suggests the need for using different penetration tactics for gaining access. However, various types of boundary highlighted in Section 6.2 indicate that it is equally vital to penetrate boundaries created by cultural and knowledge differences between the researcher and the researched. The process of priority maintaining points out the essence of achieving intellectual buy-in by promoting the value of the research project to the research site, as well as an emotional buy-in by developing trust with the researched. From the aspect of paradigm expanding, it is crucial to understand and take the researched perspective as a means of understanding the way in which their social reality is constructed. Finally, the discussion of organisational memory refining raises the needs for the researcher to provide the researched with valuable recommendations for improving their existing practices and routines. This also facilitates other processes, in particular boundary penetrating and priority maintaining.

In terms of managerial contributions and implications, this study outlines some essential guidelines for the management of cross-functional project teams, and the development of virtual teams, as well as for project management. To enable collaboration across functions, it is vital for management to ensure that various boundaries are overcome. Using incentives, developing trust, encouraging mutual learning and perspective taking

are all found to be useful. Additionally, it is vital for management to recognise that cross-functional knowledge integration cannot be treated as merely an intellectual activity. Equally important, the significance of social and emotional elements needs to be taken into account, in particular for the development of virtual teamwork. This further raises the issue that the management of cross-functional projects and project teams lies in the anticipation, understanding and appreciation of the interplay between intellectual and emotional aspects of the project.

1.6 Structure of the Thesis

The remainder of this thesis is structured as follows. Chapter Two highlights current debates and perspectives related to the areas of organisational knowledge and knowledge-related activities. Additionally, issues that are essential to the inquiry of cross-functional knowledge management are examined. Three research questions derived from the examination of the current literature are investigated. Chapter Three outlines the methodological concerns related to this study. Issues including the philosophical stance, research orientation, design, objectives, data collection methods, techniques for data analysis are also explored as a means of answering the proposed research questions. Chapter Four outlines the data collected from the first case site, the BPR Programme in BTC. Stories relating to the planning, redesign and implementation of the BPR programme are provided. Chapter Five details stories of how the millennium programme was planned, designed and implemented within NatWest GFM. Insights relating to various stages of the programme are presented. Chapter Six elaborates the research findings based on the analysis of empirical data collected from the two research

sites, as well as the comparison of the current literature outlined in Chapter Two. Finally, Chapter Seven concludes the thesis, elaborating the research limitations and future research directions, as well as addressing theoretical, managerial and methodological contributions and implications.

Chapter Two: Current Debates and Perspectives

2.1 Introduction

An increasing volume of literature has identified different types of knowledge within organisations and their interrelationships, as illustrated by the typologies of Blacker (1995) and Spender (1996). There has also been a sustained effort to investigate how knowledge is created (Nonaka and Takeuchi 1995), shared (Hansen 1999), managed (Quintas, *et al.* 1997), and learnt (Cyert and March 1963; Argyris and Schön 1978) in the organisation. Knowledge integration has come to be seen as a key foundation of competitive advantage (Grant 1996) and as a means by which organisations synthesise and co-ordinate their activities (Lawrence and Lorsch 1967). However, compared with concepts such as knowledge creation, knowledge sharing and organisational learning, the concept of knowledge integration remains underdeveloped (Hauptman and Hirji 1999). A lack of empirical evidence and coherent theoretical approaches to the conceptualisation of the knowledge integration phenomenon have provided the inspiration for this thesis to explore further these areas of concern.

Additionally, even though cross-functional project teams are increasingly formed for various purposes, such as new product development (Moenaert and Sounder 1990) and improving co-ordination (Ford and Randolph 1992), the theoretical underdevelopment of knowledge integration processes within this specific context is evident (Denison *et al.* 1996). The two primary objectives of this thesis then are to build a theory depicting the

dynamics of knowledge integration processes within the context of cross-functional project teams, as well as to identify the main issues that influence those processes.

2.1.1 Definitions

To begin with, it is important to define some key terms that will feature in the subsequent analysis. First, derived from the seminal work of Berger and Luckmann (1967) and Nonaka and Takeuchi (1995), knowledge is defined by the present study as a 'socially constructed true belief', and organisational knowledge as a 'collective socially constructed belief shared by some or all of the organisational members'. Secondly, building upon the work of Lawrence and Lorsch (1967) and the above definition of organisational knowledge, this study defines knowledge integration as 'an ongoing collective process of constructing, articulating and redefining shared belief through the social interaction of organisational members'. For the sake of convenience, we define research that investigates knowledge issues (such as the characteristics and typologies of knowledge) in the organisational context as 'organisational knowledge' studies. As Blackler (1995) observes, as well as trying to understand what people *know*, it is equally vital to investigate what they *do*. Accordingly, research that focuses on how organisational members create, share, learn and integrate knowledge in the organisational context may be seen to encompass studies of 'knowledge-related activities'. Furthermore, learning may be defined as an '*integrated cognitive and socio-emotional process*' (Kolb and Fry 1975, p. 34). This study adopts the term collective learning (Dodgson 1993) to refer to learning taking place at the team, group, organisation and inter-organisation levels.

2.1.2 Objectives and Scope of the Literature Review

This literature review has three interrelated objectives. First, it seeks to review the chosen literature critically and sympathetically in order to expose current debates and perspectives in the chosen areas of investigation. This leads directly to the second objective, which is to identify major theoretical gaps that need to be filled. Following on from this, the third objective is to formulate researchable questions and an appropriate data collection strategy that addresses the need for further theoretical development.

The two main bodies of literature reviewed in this study are those concerning organisational knowledge and knowledge-related activities. In addition, various theories and ideas rooted in the study of organisational behaviour, group dynamics, strategy and innovation are also examined. In the field of organisational knowledge, considerable attention has already been given to the typologies and characteristics of knowledge. In addition, concepts such as paradigm (Kuhn 1970) and organisational memory (Walsh and Ungson 1991) have been regularly discussed, often in association with such ideas as organisational knowledge base[1] (Boisot and Grifiths 1999) and knowledge architecture[2] (Rebentisch and Ferretti 1995).

The rationale behind focusing on these two specific areas is fourfold. First, a typology provides an ecological view on the different kinds of knowledge existing within the organisation. Secondly, an analysis of the characteristics of organisational knowledge

[1] According to Boisot and Griffiths (1999), knowledge base refers to the domain within which the intellectual capital possessed by an organisation is allocated.
[2] Knowledge architecture refers to the collection of various types of organisational knowledge such as technology, operating procedures and organisational structure (Rebentisch and Ferretti 1995).

helps to explain the complexity of organisational knowledge and suggests that a holistic view of the dynamics of knowledge in an organisational context is needed (Star 1989). Thirdly, it is important to clarify the conceptual ambiguity between organisational knowledge, organisational memory and paradigm – terms that are often used interchangeably, for example in studies by Stein and Zwass (1995) and Wang (1999). As far as knowledge-related activities are concerned, for the sake of convenience this review distinguishes between knowledge creation, knowledge sharing, collective learning and knowledge integration. This decision is based on two major considerations: (1) in view of the need to take a broad view of the concept of 'knowing' (Blackler 1995), as indicated earlier, it is clear that merely reviewing the literature on organisational knowledge is not sufficient for the purpose of understanding the process of knowledge integration; (2) the concept of knowledge integration processes cannot be studied in isolation from other knowledge-related activities.

2.1.3 The Key Research Questions and the Structure of the Literature Review

Three key research questions, articulated through a review of the main body of the literature, may be summarised as follows:

- What are the key processes that underlie knowledge integration within the cross-functional project team?
- What are the interrelationships between these key knowledge integration processes?
- What are the major issues which influence processes of knowledge integration?

The main body of this literature review is divided into four parts: organisational knowledge, knowledge-related activities, the social construction perspective, and theoretical gaps and research questions. The rationale behind this structure is that the understanding of organisational knowledge serves as the first step in investigating knowledge-related activities in the organisational context. This in turn helps to consolidate and compare different research findings on knowledge-related activities with empirical evidence generated by this study. The social construction perspective forms the basis of the theoretical approach adopted in this study to investigate the dynamics of knowledge integration processes. Based on a review of the existing literature, and using the chosen perspective, major theoretical gaps are then identified and key research questions formulated.

After formulating a definition of knowledge, a discussion of knowledge typologies follows. Knowledge-related concepts such as paradigm and organisational memory are then analysed, and the main characteristics of organisational knowledge, memory and paradigm are identified. The value of knowledge, as seen by different schools of thought, is then discussed. The second body of literature is concerned with central debates and perspectives on knowledge-related activities. A discussion of knowledge creation is followed by a review of knowledge sharing, a consideration of collective learning, and an exploration of the development of a cross-functional knowledge integration theory. Finally, after discussing the social construction perspective, key research questions are identified.

2.2 Knowledge in Organisations

2.2.1 What is Knowledge?

Debates about the nature of knowledge can be traced back to the ancient Chinese and Greeks. These have been characterised by enduring battles between different schools of thought and a resulting failure to achieve agreement. This thesis does not seek to prolong these ongoing arguments. For the sake of convenience, it combines Berger and Luckmann's (1967) social construction perspective and Nonaka and Takeuchi's (1995) theory, and defines knowledge as a socially constructed true belief. According to the social construction perspective, knowledge is constructed by the interaction of social actors and represents the way in which reality is interpreted within a specific social setting. This perspective provides a lens to examine and consolidate other relevant concepts that represent knowledge within various social contexts, for example the concepts of paradigm and organisational memory.

2.2.2 The Importance of Knowledge

The importance of knowledge is widely recognised in many research disciplines. This study concentrates on three categories of literature which together provide different insights into the significance of knowledge: the societal, economic and strategic.

2.2.2.1 The Societal Focus

Rapid change in our society means that the only certainty is uncertainty (Nonaka and Takeuchi 1995). For many scholars, it is the emergence of the knowledge society that has triggered such rapid change (Drucker 1968; Sheptycki 1998; Toffler 1990). The

critical importance of knowledge to the post-industrial society is emphasised by Bell (1973). A similar viewpoint is expressed by Drucker (1999), who notes that: '*the most valuable asset of a 21st century institution (whether business or non-business) will be its knowledge workers and their productivity*' (p. 79).

Research in IT and IS also underlines the social impact of knowledge. In particular, studies of the '*information age*' (e.g. Brown 1999 and Lynch and Lynch 1996) point to the crucial role of information and communication technology (ICT) in catalysing societal change. The low cost and increased efficiency of acquiring information is widely seen as a vital issue in facilitating knowledge creation (Nambisan, Agarwal and Tanniru 1999). One of the most critical issues revealed by the societal focus is the need for organisations to effectively acquire knowledge from the external environment as a basis for knowledge integration.

2.2.2.2 The Economic Focus

The essence of knowledge in relation to production and cost was first recognised by economists, in particular those who advocated the concept of a learning curve. The basic assumption of this concept is that organisations gradually learn through their production processes. As the volume of production increases, organisations benefit from a reduction in time and cost per unit produced because of the experience and knowledge they have gained (Argote, Beckman and Epple 1990; Arrow 1962; Epple, Argote and Devadas 1996; Yelle 1979). The learning curve concept is similar to Cyert and March's (1963) idea of the organisation's '*adaptive behaviour*'.

It is clear, then, that organisations can successively improve their performance and efficiency based on the knowledge they accumulate over time. The major contribution made by the economic perspective lies in the recognition of the application of past experience to future use. However, the learning curve concept presumes that the market is in equilibrium, and therefore does not take account of environmental change. The modification of the process by which organisations articulate, integrate and utilise their knowledge in order to respond to environmental change is largely ignored in learning curve research. For example, as Jelinek and Goldhar (1984) observe, the increasing demand for customised products means that firms must modify and utilise their knowledge in ways which are quite different from those associated with the process of mass production.

2.2.2.3 The Strategic Focus

The importance of knowledge, in particular knowledge that is embedded within the organisational context, is extensively explored and exploited by the strategy researchers. The strategic value of knowledge is given particular emphasis in the resource-based view (Prahalad and Hamel 1990; Wernerfelt 1984) and knowledge-based view of the firm (Foss 1996; Grant 1996; Spender 1996). Each of these approaches will now be discussed in turn.

2.2.2.3.1 The Resource-based View of the Firm

The resource-based view of the firm, as advocated in the work of Wernerfelt (1984), underlines the importance of '*resources endowment*' in relation to the firm's strategic options. Conventionally, the strategic management literature focuses primarily on

identifying categories of resources (including tangible resources such as finance capital and human resources) and then developing such resources in relation to the firm's performance (e.g. Nkomo 1987; Penrose 1959; Wissema, Brand and Van Der Pol 1981). By contrast, the resource-based view emphasises the central importance of the firm's '*capabilities*' in utilising and integrating its resources as a means of obtaining competitive advantage (Grant 1996; Prahalad and Hamel 1990; Teece, Pisano and Shuen 1997). It is argued that the capabilities embedded within organisational routines are developed over time and are intrinsically intangible, difficult to imitate and hard to transfer (Conner and Prahalad 1996; Kogut and Zander 1992; Wernerfelt 1984).

2.2.2.3.2 The Knowledge-based View of the Firm

By synthesising such concepts as the resource-based view and organisational learning and innovation, the knowledge-based view of the firm specifically emphasises the strategic and managerial importance of knowledge embedded within firm-specific capabilities (Grant 1996; Grant and Baden-Fuller 1996). Firms with their unique knowledge bases can be considered as an inventory of expertise, and such firms are termed by Mueller and Dyerson (1999) as 'fractal organisations'. The emerging theory aims to elaborate the existence and competitive advantage of the firm based on the firm's role in co-ordinating various knowledge-related activities such as knowledge creation (Nonaka and Takeuchi 1995), utilisation (Spender 1996) and integration (Demsetz 1991; Lawrence and Lorsch 1967). As indicated by Spender (1996), knowledge, as a dynamic concept embedded within actor networks, should not be considered merely as a resource, but as a process. This is reflected in the notion of '*knowing*' (Blackler 1995), which stresses that the investigation of the dynamics of

organisational knowledge should not be limited to articulating what people know. Instead, it must also seek to understand the processes by which knowledge is acquired, created and applied through organisational members organising, co-ordinating and performing their activities. The essence of these processes mirrors the fundamental role of the firm, which is to bring together all its specialised knowledge (Grant 1996). This pinpoints the importance of knowledge integration in relation to organisational competitive advantage.

2.2.3 Emerging Issues

The relationship between the utilisation of knowledge and competitive advantage (or, in Nahapiet and Ghoshal's (1998) term, organisational advantage) has been scrutinised across a spectrum of studies. In particular, studies of product innovation and knowledge creation suggest that existing organisational knowledge provides a foundation for stimulating the creation of new knowledge (Matusik and Hill 1998; Nahapiet and Ghoshal 1998; Nonaka and Takeuchi 1995; Quintas, *et al.* 1997; Souder 1987). Several issues revealed by strategic researchers point to the need for further investigation, especially in relation to knowledge integration within the organisational context. Two particularly important questions are: What preconditions are necessary to foster and sustain organisational knowledge? What is the role of knowledge integration in relation to the creation of organisational knowledge?

From the above discussion of the resource-based and knowledge-based views of the firm, it is clear that strategic researchers generally see the value of knowledge as unconditional, i.e. knowledge has an absolute value in leveraging firm's strategy.

However, these scholars overlook the fact that organisational knowledge can become obsolete, in which case it must be discarded. The obsolescence of organisational knowledge is discussed by Hedberg (1982), Nystrom and Starbuck (1984) and McGill and Slocum (1993), who argue that any organisation wishing to learn must also develop the capacity to '*unlearn*'. This leads to another important question: How do organisations or organisational units unlearn through the processes of knowledge integration?

2.2.4 Typologies of Knowledge

Typology studies have enhanced our understanding of the various forms of knowledge resident in the organisation. The different typologies proposed by scholars reveal how they see knowledge in the organisation as a whole, as well as how they divide knowledge, according to its theoretical and operational nature, into various clusters. Typologists have played a pioneering role in developing the concept of organisational knowledge, even though some of their concepts have no empirical basis and remain at the conceptual level. The following section considers the basic concepts of these typologies, as well as their interrelationships within the organisational context.

The tacit and explicit dimensions of knowledge were first articulated by Michael Polanyi (1958), who showed that it is not easy for people possessing tacit knowledge (e.g. knowledge of how to skate) to articulate and transfer that knowledge by verbal description. By contrast, explicit knowledge can easily be codified and transferred through written or verbal explanation. For Polanyi, all knowledge contains elements of both tacitness and explicitness. Hence, it is useful to think of a continuum with tacit

knowledge at one end and explicit knowledge at the other. Polanyi focuses primarily on the individual's capability to acquire and transfer tacit and explicit knowledge. His exploration of the communicability and transferability of knowledge is especially significant for an understanding of knowledge sharing in organisations.

The distinction between tacit and explicit knowledge can also be found in other typologies. For instance, Sanchez and Heene (1997) distinguish between three types of knowledge: know-what, know-how and know-why. Know-what, referring to the descriptive components of knowledge in a codified form, is similar to the concepts of dictionary knowledge (Sackmann 1991) and declarative knowledge (Cohen and Bacdayan 1994; Cohen and Sproull 1996). All three concepts can be seen to correspond to Polanyi's (1958) category of explicit knowledge. The primary focus of all these concepts is the 'what' facts, propositions and events that are stored.

By contrast, know-why, as suggested by Sanchez and Heene (1997) is similar to the concept of axiomatic knowledge as defined by Sackmann (1991): '*ultimate explanations exist referring to "why certain events happen"*' (p. 37). In terms of Polanyi's (1958) typology, know-why and axiomatic knowledge are similar to tacit knowledge. The emphasis here is on 'why' knowledge is constructed.

The third type of knowledge, know-how (Sanchez and Heene 1997), is similar to the concept of directory knowledge as defined by Sackmann (1991): '*causal-analytical attributions representing commonly held theories of actions*' (p.36). Similarly, conceptual overlaps between know-how and procedural knowledge (Cohen and

Bacdayan 1994) are evident. Know-how, procedural knowledge and axiomatic knowledge refer to the form of experience-based knowledge that is acquired through the process of doing (Kolb and Fry 1975). In comparison with the previous two types of knowledge (know-what and know-why), know-how, procedural knowledge and directory knowledge can be either tacit or explicit. For instance, technological know-how can be codified in a written form and protected by its patent right. On the other hand, know-how can be embedded within the craftsman's skill, and this can be tacit in nature. The primary focus here is on 'how' knowledge is constructed.

Spender (1996) expands the distinction between the tacit and explicit dimensions of knowledge to the organisational level, and adds the social dimension into his typology. He argues that there are four types of knowledge: conscious, automatic, objectified and collective. The first two types are individual forms of knowledge, but conscious knowledge is explicit and automatic knowledge is tacit. In contrast, the third and fourth types of knowledge are social knowledge, in which objectified knowledge indicates the explicit aspect and collective knowledge refers to the tacit aspect. Despite their terminological differences, there are theoretical overlaps between Spender's (1996) typology and Matusik and Hill's (1997) concept. Instead of using the individual/social distinction, Matusik and Hill divide organisational knowledge into the private and public domains, based on the concept of '*permeable organisational boundaries*'. Both typologies concentrate on the accessibility of knowledge and the issue of knowledge ownership, in addition to the transferability and communicability of knowledge. As far as individual, private knowledge is concerned, it is clear that it can be either tacit or explicit, but the ownership of knowledge prevents other people from understanding,

learning and imitating it. Public, social knowledge can also be either tacit or explicit. However, because of its pattern of ownership, it involves fewer boundaries that restrain other people from gaining access to the knowledge in question.

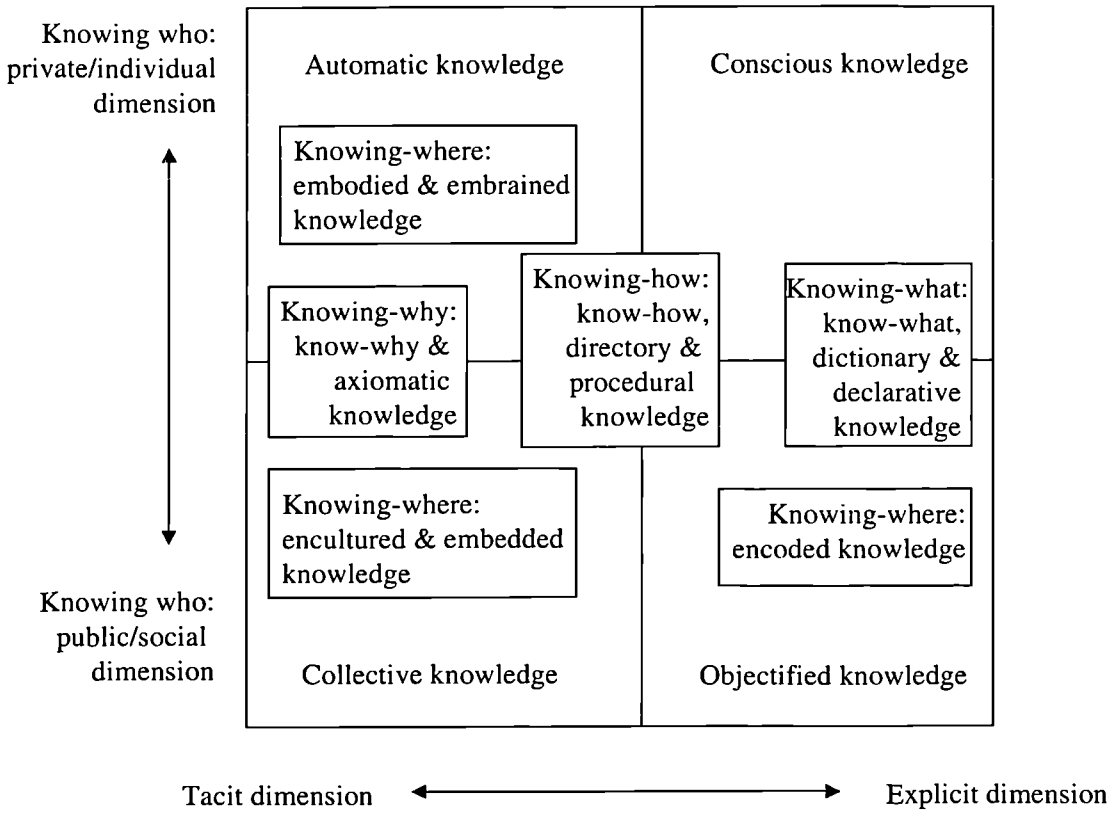
The concept of embrained, embedded, encoded, encultured and embodied knowledge (Blackler 1995; Collins 1993) provides an alternative approach to understanding knowledge in organisations. Building upon the work of Collins (1993), Blackler (1995) further analyses these five types of knowledge within the organisational context according to their role, the location in which the knowledge resides, and the way in which knowledge is constructed. For Blackler, instead of just trying to understand what people *know*, it is more important to investigate what they *do*. This is reflected in his concept of '*knowing*' in relation to the value of knowledge. Similar arguments can be found in Sanchez and Heene's (1997) study, which reveals that the value of knowledge lies in its applications rather than in the knowledge *per se*. This means that the strategic value of knowledge can be leveraged only through its use.

2.2.5 An Integrative View of Knowledge Typologies

The present review adopts the concept of 'knowing' advocated by Blackler (1995), and seeks to integrate the various knowledge typologies into a five-fold categorisation of knowledge: knowing-how, knowing-what, knowing-why, knowing-who and knowing-where (see Figure 2.1). More specifically, Figure 2.1 represents an integration of the work of Polanyi (1958), Matusik and Hill (1998) and Spender (1996). It contains two broad dimensions: the tacit/explicit and private (individual)/public (social). The first dimension refers to the nature of knowledge according to its transferability and

communicability. The second dimension reflects the 'ownership' and accessibility of knowledge. Therefore, this review terms this dimension as 'knowing-who'. In other words, knowing who possesses the required knowledge as part of organisational practice. For the convenience of discussion, the study uses the overall space within the two dimensions as a 'map' that presents different types of knowledge in the organisational context.

Figure 2.1 the landscape of knowledge in the organisational context.



According to Spender (1996), the automatic, collective, conscious and objectified forms of knowledge occupy four distinctive parts of the knowledge map, based on their nature and ownership. The five types of knowledge identified by Collins (1993) and Blackler (1995) represent five distinctive places where knowledge resides. For instance,

embedded knowledge refers to knowledge that resides in operational procedures or organisational routines. According to this variation in the location of knowledge, this study places the five types of knowledge, namely embodied, embedded, encoded, encultured and embrained, into the category of 'knowing-where'. In other words, knowing where knowledge is located serves as a critical mechanism for carrying out activities that demand knowledge that is dispersed across various organisational units. Embodied and embrained knowledge, as the representation of individual's experience and skill, are tacit in nature. By contrast, encultured and embedded knowledge, which are tacit in nature, are socially constructed by organisational members (Blackler 1995). Encoded knowledge, which exists in written form (e.g. in documents), is explicit in nature and can be accessed by a large number of organisational members. Know-why and axiomatic knowledge are placed in the category of 'knowing-why' because of their focus on the rationale of why knowledge is constructed. This study uses the term knowing-why to reflect the ongoing processes of rationalisation underlying organisational activities, instead of regarding know-why or axiomatic knowledge as something static. A similar argument can be applied to the following two concepts. Know-how, directory and procedural knowledge are categorised into 'knowing-how'. Finally, as representation of facts and propositions, know-what, dictionary and declarative knowledge are allocated to the category of 'knowing-what'.

Locating the five types of knowing on the organisational knowledge map helps not only to generate a synthesised view of the various knowledge typologies, as a means of understanding their interrelationships, but also helps to identify major theoretical gaps in the knowledge typology literature. From Figure 2.1, it is clear that knowledge required

by different organisational activities, as represented in various forms of knowing, can all be evaluated based on the private/public and tacit/explicit dimensions. For instance, knowing-what, the knowledge underlying the activities of understanding facts and propositions, can be either private or public. However, in terms of its nature, it is closer to the explicit end than the tacit end. Knowing-why can also be either public or private, but it is relatively more tacit than knowing-what. Similarly the concept of knowing-how can be private or public. However, knowing-how differs from knowing-why and knowing-what, and can be located virtually anywhere in the tacit/explicit continuum.

In comparison with the other five types of knowing, it is clear that the concept of 'knowing-when', absent from the knowledge map, is relatively underdeveloped. Since it refers to the time dimension of knowledge, 'knowing-when' can be a vital issue in distinguishing between the proactive and reactive actions taken by organisational members. Additionally, it can be an indicator of when actions should be taken, i.e. in terms of prioritisation. Furthermore, the concept of 'knowing-when' can also help to identify the obsolescence of knowledge, thereby showing when organisations should 'unlearn' (Hedberg 1982). Interrelationships between the various types of knowing and the key knowledge integration processes is elaborated in Chapter Six.

2.2.6 Knowledge-related Concepts

In the management literature there are several concepts that are used interchangeably with 'knowledge'. For example, knowledge is often regarded as skill (Haines 1999; Kanter 1999;), experience (March, Sproull and Tamuz 1991; Levitt and March 1988) and expertise (Starbuck 1992; Mueller 1996; Mueller and Dyerson 1999). Knowledge is

also seen in terms of the organisation's capabilities in managing resources – this is expressed clearly in the resource-based view of the firm (Grant 1996; Prahalad and Hamel 1990; Teece, Pisano and Shuen 1997). Terms such as skill, experience and expertise emphasise the embodied and embrained nature of knowledge (Blackler 1995; Collins 1993), and overlap conceptually with the idea of automatic knowledge, as proposed by Spender (1996). In other words, the skill, experience and expertise residing within individuals can only be acquired, refined and utilised by individuals. This indicates that individuals are the principle owners of knowledge. It is beyond the scope of this review to further differentiate between these three terms. Referring to Figure 2.1, concepts such as skill, experience and expertise, stressing the embodied and embrained nature of knowledge and individual ownership, can be located in the top left corner of the knowledge map.

On the other hand, capabilities address the collective form of knowledge, which is constructed jointly by organisational members. Capabilities in utilising firms' resources are often embedded in organisational routines, procedures and culture (Grant 1996). They may also be documented in written forms such as operating manuals. Referring to the knowledge map in Figure 2.1, capabilities overlap with encultured, embedded and encoded knowledge (Blackler 1995; Collins 1993) and collective and objectified knowledge (Spender 1996). Hence, capabilities can be located in the bottom half of the knowledge map in Figure 2.1.

The terms 'paradigm' and 'organisational memory' are also associated with the concept of knowledge, often in referring to different forms that represent the aggregation of

knowledge at the community and organisational levels. Hence, paradigm and organisational memory can be located in the bottom half of the knowledge map in Figure 2.1. These two concepts are used in various studies (e.g. Boland and Tenkasi 1995; Hagadon and Sutton 1997; Roth and Kleiner 1998) which investigate knowledge in the organisational context, especially when explaining the nature of collective knowledge and also its construction processes (Brown and Duguid 1991).

2.2.6.1 Paradigm

The concept of paradigm is scrutinised in Kuhn's (1970) book *The Structure of Scientific Revolutions*. He defines a paradigm as '*the constellation of group commitments*' (p. 181) and as '*shared examples*' (p. 187) of the community members. He further explains that paradigms are '*some accepted examples of actual scientific practice -- examples which include law, theory, application, and instrumentation together-- provide models from which spring particular coherent traditions of scientific research*' (p. 10). According to Kuhn, a paradigm represents both the underlying logic of a group of scientists who share the same belief about reality, and also the way in which that reality is investigated. Kuhn emphasises that a paradigm pursued by one group (community) of people may not be considered as acceptable by others. This reflects one of Kuhn's core arguments which is the incommensurability between different paradigms. Scientific revolutions are triggered by the processes of confronting, modifying and fighting for dominance between different paradigms. However, applying the concept of paradigm in the organisational context, it is questionable whether paradigmatic differences are as incommensurable as Kuhn suggested. For instance, Boland and Tenkasi (1995) discuss the concept of 'perspective taking' and 'perspective making' and indicate the possibility of resolving

paradigmatic differences through understanding different paradigms pursed by individuals. By synthesising the definition of knowledge illustrated in section 2.1.1 and Kuhn's (1970) insights, as well as incorporating Boland and Tenkasi's (1995) notion, a paradigm as used here is defined as 'a group reality or frame of reference that is collectively constructed and accepted by the group's members'. Such a definition reflects the social constructive nature of a paradigm, as well as the possibility that paradigmatic differences can be resolved through social interaction between organisational members.

In contrast to Kuhn's (1970) study that examines paradigm in the context of a science community, this study applies such a concept primarily in the context of an organisation. The relevance of the concept of paradigm for studying knowledge in the organisational context is addressed by Boland and Tenkasi (1995):

> '*Kuhn's insights are particularly relevant for understanding how knowledge is produced in a community of knowing by refining and clarifying the perspective of the community. Development of knowledge in a community is a process of posing and solving puzzles, thereby elaborating and refining the vocabulary, instruments and theories that embody the perspective*' (p. 354).

For Boland and Tenkasi, the term 'perspective' is used to indicate the 'paradigm' pursed by a community. The present study extends the approach taken by Boland and Tenkasi and employs the term paradigm to represent group knowledge, regardless of the formalised departmental boundaries imposed by the organisational structure. Thus, this

study does not assume that members of staff within the same department necessarily share the same paradigm. Instead, this study suggests a community of practice (Brown and Duguid 1991; Lave and Wenger 1991; Orr 1990; Wenger and Snyder 2000) as a better approach to defining the boundary of a paradigm. On the other hand, the existence of different communities within an organisation suggests that there will be paradigmatic differences. The following section will elaborate such diversity by using the concept of organisational memory. The concept of community of practice is considered in more depth at a later stage of the analysis (see below).

2.2.6.2 Organisational Memory

2.2.6.2.1 The Nature of Organisational Memory

Another important concept that depicts knowledge at the organisational level is that of organisational memory. Despite the fact that the terms 'knowledge architecture' (Rebentisch and Ferretti 1995), 'knowledge base'[3] and 'organisational memory' have relatively similar meanings, this study chooses the last of these terms to represent the multi-layers and the interrelated nature of knowledge assets within the organisation. Organisational memory exists in various forms: the shared mental model (Senge 1990), working procedure (Hackbarth and Grover 1999), history (Hall 1984), organisational routines (Cyert and March 1963) and organisational culture (Walsh and Ungson 1991).

The concept of organisational memory has been explored from various disciplinary perspectives. For instance, in the strategic alliance context, it is evident that gaining access to a partner firm's organisational memory serves as a vital means of acquiring

[3] Knowledge base refers to the domain within which the intellectual capital possessed by an organisation is allocated (Chang and Chung 1994; Davidson, Roy and Ludden 1999).

new knowledge (e.g. Inkpen 1998; Lane and Lubatkin 1998). Within the area of information systems research, efforts have been made to develop organisational memory information systems (Hackbarth and Grover 1999; Stein and Zwass 1995; Wang 1999) and knowledge management information systems (Nissen 1999) for managing internal information and capturing external information. From the perspective of organisation science, the notion of organisational memory is particularly useful in explaining the existence of organisational knowledge that is not diminished by the replacement of organisational members (Walsh and Ungson 1991; Weiser and Morrison 1998), but is enhanced and stimulated through the enrolment of new members (Huber 1991). Additionally, it is agreed that an organisation's effectiveness lies in the deployment of knowledge and lessons articulated from the past (Hagadon and Sutton 1997). From a strategic perspective, organisational memory helps organisations avoid consistently having to '*reinvent the wheel*' (Roth and Kleiner 1998).

2.2.6.2.2 Definitions of Organisational Memory

Adopting an information processing perspective, Walsh and Ungson (1991) define organisational memory as '*stored information from an organisation's history that can be brought to bear on present decisions*' (p. 61). Day (1994) refers to organisational memory as '*a repository for collective insights contained within policies, procedures, routines, and rules that can be retrieved when needed*' (p. 44). Moorman and Miner (1997) define organisational memory as '*collective belief, behavioural routines, or physical artefacts that vary in their content, level, dispersion, and accessibility*' (p. 93). It is clear from these definitions that organisational memory has the characteristics of collectiveness, dispersion and multiple-forms of existence. This study adopts the

definitions of Day (1994) and Moorman and Miner (1997) for the following reason: they provide clear explanations of the nature of organisational memory and the well-defined boundaries of organisational memory. Also, they have broader implications for knowledge-related activities than the definition provided by Walsh and Ungson (1991). Furthermore, these two definitions are conceptually complementary: Day (1994) emphasises the multiple-forms of existence of organisational memory, and Moorman and Miner (1997) concentrate on the utilisation of organisational memory.

2.2.6.3 The Interrelationship between Paradigm, Organisational Knowledge and Organisational Memory

2.2.6.3.1 Introduction

Despite the fact that the terms 'paradigm', 'organisational knowledge' and 'organisational memory' are used intensively in the management literature, there is no clear distinction between them. In order to avoid terminological ambiguity, this study attempts to clarify the meaning of each of these three concepts. Within this section, the characteristics and interrelationships of paradigm, organisational knowledge and memory are discussed according to their conceptual similarities and differences. Based on a review of the current literature, three dimensions (level of existence, dispersion and construction) are taken as a basis for comparing the three terms (see the summary in Table 2.1).

2.2.6.3.2 Level of Existence

This study recognises the characteristic of multiple-levels of existence shared by paradigm, organisational knowledge and organisational memory. The multiple-levels

refer to individuals, groups and the organisation as a whole (Kiesler and Sproull 1982; Matusik and Hill 1998; Sandelands and Stablein 1987). In contrast with the emphasis of organisational knowledge and organisational memory on the organisational level, a paradigm exists mainly at the community level (Kuhn 1970). In other words, a paradigm is regarded as community specific (Boland and Tenkasi 1995).

Table 2.1 a comparison of paradigm, organisational knowledge and organisational memory according to three dimensions.

Dimension	Paradigm	Organisational knowledge	Organisational memory
Level of existence	Mainly at the community level, but it can possibly be fully represented by individuals	Composed of individual, group and organisational levels, but the aggregation of individual knowledge cannot represent group or organisational knowledge	Composed of individual, group and organisational levels, but the sum of individual memory is not equal to group or organisational memory
Dispersion	Dispersed within specific communities or groups due to its communicability	Selective dispersion due to its accessibility and context dependence	Selective dispersion due to its accessibility and different retention facilities
Construction	Constructed through the process of 'legitimate peripheral participation' between community members	Constructed through the integration of individual and group knowledge cross-functionally	Constructed through modifying and refining existing routines, procedures, and knowledge

Despite the fact that these three concepts are used mainly in collective forms, individuals, as the primary players, are vital in constructing and changing a paradigm, organisational knowledge and organisational memory. In particular, this is evident in those organisations where the individual's expertise is difficult to replace, as is the case for example, with designers in the fashion industry or a conductor in an orchestra.

'Paradigm' is the only one of the three concepts that can represent meaningfully the differences at the individual level. In other words, paradigmatic differences can be found not only between groups but also between individuals. This can be explained by the way in which a paradigm is embedded. From Kuhn's (1970) description, it is clear that each scientist belonging to the same community can fully represent his own distinctive paradigm. By contrast, it is less likely that an individual can represent the whole organisational knowledge and memory.

At the collective level, groups or organisations as a whole are able to articulate information and knowledge, whereas this is often technically impossible for any individual (Huber 1991). Hutchins (1991) presents evidence of how a team of cruisers learns collectively through a sudden environmental change, namely the breakdown of the navigation system. Hutchins' research provides empirical evidence to illustrate a commonly shared assumption, which is that '*the whole can be greater than the sum of individuals*', as well as the existence of memory and knowledge at the group level. At the organisational level, organisational knowledge and memory are vital in explaining the existence of a distinctive form of collective knowledge that differs from the mere aggregation of the knowledge of individual members (Nahapiet and Ghoshal 1998). Therefore, the essence of studying these concepts lies in the need to incorporate these three levels into the account.

2.2.6.3.3 Dispersion

The dispersion of organisational knowledge and memory is highlighted by various studies. Despite the fact that a paradigm is community-specific, as Boland and Tenkasi

(1995) suggest, and reflects a group's social identity (Tajfel and Turner 1985), the dispersion of paradigm is comparatively less well examined and discussed. As Walsh and Ungson (1991) indicate, '*organisational memory is not centrally stored, but distributed across different retention facilities*' (p. 62). In other words, there is a clear dispersion of organisational memory. At the same time, the dispersion of organisational knowledge is emphasised by Tsoukas (1994).

However, there are different views of the degree and content of knowledge dispersion. This suggests that organisational knowledge and memory are context dependent and are therefore distributed selectively within the organisation (Cohen and Levinthal 1990; Moorman and Miner 1997; Smircich 1983). As Moorman and Miner (1997) observe, '*organisational memory also varies in accessibility, or the extent to which it can be retrieved for use ... the presence of distinct organisational subcultures suggest that memory is not necessarily shared by all members*' (p. 93). The selective distribution of organisational knowledge and memory then suggests another critical concern is the issue of accessibility. This is reflected in what Walsh and Ungson (1991) call the '*abuse of organisational memory*' in which organisation members yield power by controlling the accessibility of organisational memory. Similar arguments related to the accessibility of organisational knowledge are reflected in the explication of the relationship between knowledge and power. The close relationship between power and the control of organisational knowledge and memory inevitably affects the accessibility of such knowledge (Feldman and March 1981).

Turning to a paradigm, its selective dispersion centres on the communicability created by paradigmatic differences (Nemetz and Christensen 1996). In particular, some studies (e.g. Cespedes 1996; Conger 1998) emphasise the role of the management of paradigmatic differences as a means of improving cross-functional communication and collaboration. Based on the above discussion of selective dispersion, it is clear that accessibility and communicability, as two distinctive but interrelated issues, are equally vital in understanding the three concepts.

2.2.6.3.4 Construction

Finally, it is clear that paradigm, organisational knowledge and memory represent three different forms of reality that are collectively constructed by the organisational members. According to Kuhn's (1970) account, a paradigm is formed jointly through the social interaction of scientists who accept the same examples of actual scientific practice. The importance of social interaction in constructing a paradigm is reflected in the process of '*legitimate peripheral participation*', as defined by Lave and Wenger (1991). In terms of organisational knowledge, the importance of social interaction is also evident. This is illustrated in the concept of '*socialisation*' as one of the processes of '*knowledge creation theory*' and the phenomenon of knowledge creation spiral, as proposed by Nonaka and Takeuchi (1995). In contrast with the literature on paradigms and organisational knowledge, the literature on organisational memory pays less attention to social interaction, in particular in relation to how organisational memory is constructed and deconstructed.

Despite the fact that these three concepts all refer to socially constructed reality, there are clearly some differences between them. A paradigm, as a set of shared examples and a mental model, influences the way in which organisational knowledge is constructed. In other words, individuals or groups interpret and create knowledge based on the paradigm they pursue as a frame of reference (Habermas 1987; Nonaka and Takeuchi 1995). The creation of new knowledge, at both the individual and collective levels, is gradually utilised and incorporated into day-to-day activities. This is reflected in the importance of procedural and declarative knowledge in forming organisational routines (Cohen and Bacdayan 1994). Based on the definitions provided by Day (1994) and Moorman and Miner (1997), it is clear that organisational routines in conjunction with other elements, such as procedures, policies and physical artefacts, form organisational memory.

2.2.6.4 Emerging Issues

In this research, the emphasis is on organisational knowledge and the process of knowledge integration, but consideration is also given to the nature and scope of paradigms and organisational memory. This is triggered not only by the conceptual similarities between these three concepts, but also by the theoretical gaps identified in the discussion of their interrelationships. Most importantly, it is clear that paradigmatic differences at the individual and group level influence not only the construction of organisational knowledge, but also the modification of organisational memory. Hence, the way in which paradigmatic differences are managed must be considered a vital issue in studying knowledge integration within the organisational context.

The above discussion of the dispersion issue indicates that accessibility has become a key concern in the organisational knowledge and memory literature, while the discussion of paradigms primarily emphasises the phenomenon of the communicability of organisational knowledge and organisational memory. Thus, in terms of this study of knowledge integration, it is essential to incorporate the analysis of accessibility and communicability into the examination of the three concepts.

Finally, it is clear from the above discussion that the role of social interaction in relation to the construction of organisational memory has hitherto received little systematic attention. Therefore, this study seeks to take into account the influence of social interaction in relation to the three core concepts. This is not only to enhance the understanding of the construction of organisational memory, but also to investigate how paradigmatic differences can be managed as a means of integrating dispersed organisational knowledge. However, before the three core concepts can be further investigated, it is vital to understand the context within which social interaction takes place. The following section reviews various viewpoints proposed for understanding organisations.

2.2.7 Viewpoints Related to Organisations

As Morgan (1997) argues, virtually every organisation can be seen as a system. This view is in accordance with the perspective of contingency theory and systems theory, which sees organisations as systems containing dynamic interactions of subsystems (Lawrence and Lorsch 1967; Nadler 1981; Savage 1990). This approach is also reflected in some of the group dynamics and teamwork research (e.g. Eales-White 1992; Eby and

Dobbins 1997; Wheelan 1994), which perceives teams as organisational subsystems. However, debates on the nature of systems and how organisations interact with their environments extend further into three different streams, namely closed systems, open systems and loosely coupled systems. One of the main differences between open and closed systems lies in the way in which certainty and uncertainty are perceived and managed (Gresov and Drazin 1997; Neumann 1997; Reed, Lemak and Hesser 1997; Toffler 1982). With closed systems, organisations are constantly engaged in finding orders which separate them from external uncertainty by emphasising efficiency, standardisation and routinisation (Cameron, Kim and Whetten 1987). On the other hand, open systems theorists perceive organisations as interacting and exchanging energy with their external environments and continuously facing uncertainty (Jantsch 1980; Neumann 1997; Thompson 1967; Von Bartalanffy 1976). The characteristics of a loosely coupled system are discussed below.

2.2.7.1 The Organisation as a Loosely Coupled System

Taking an integrative perspective, scholars such as Glassman (1973), Orton and Weick (1990) and Weick (1976) argue that organisations may be seen as '*loosely coupled systems*'. A loosely coupled system is defined by Weick (1976) as '*a situation in which elements are responsive, but retain evidence of separateness and identity*' (p. 3). Two characteristics of loosely coupled systems highlighted by Orton and Weick (1990) are '*responsiveness*' and '*distinctiveness*'. When there is responsiveness without distinctiveness, the system becomes tightly coupled. On the other hand, when the system has distinctiveness without responsiveness, it becomes decoupled. When the system contains both distinctiveness and responsiveness, it becomes loosely coupled. The

concept of a loosely coupled system helps to explain situations in which open and closed systems co-exist within the organisation, representing different sides of the same coin. This is reflected in the seminal work of Spencer and Grinyer (1996), who argue that '*organisations are both determinate closed systems searching for certainty, and open systems expecting uncertainty*' (p. 25).

The implications of considering an organisation as a loosely coupled system in studying knowledge-related activities are threefold. First, this perspective is useful in explaining the relationships between knowledge which is selectively dispersed within the organisation (Blackler 1995; Spender 1996; Spender and Grinyer 1996). Secondly, the concepts of '*distinctiveness*' and '*responsiveness*', proposed by Orton and Weick (1990), are useful in explaining the differences and interrelationships between knowledge embedded within various organisational contexts, as well as showing how knowledge constructed in different organisational contexts is utilised in business activities. One example is the study of '*communities of practice*' (Brown and Duguid 1991; Wenger and Snyder 2000), which differentiates the '*canonical*' practices acquired from formal training from the '*non-canonical*' practices shared through storytelling. Finally, the importance of '*responsiveness*' as the '*glue*' which couples systems together (Orton and Weick 1990), elaborates the resource interdependence between systems. This is reflected in the '*resource dependence theory*' advocated by Pfeffer and Salancik (1978).

2.2.7.2 From Resource Dependence Theory to the Essence of Resource Allocation

Instead of simply providing another account of how organisations use resources to maximise their outputs, resource dependence theory is conceptualised on the basis of how organisations acquire resources as a means of survival (Pfeffer and Salancik 1978). According to this view, inevitably organisations depend on resources from the external environment which they have very little control of, so that organisations have to change their activities to ensure the ongoing availability of vital resources by managing and avoiding dependence relationships, as well as by maintaining relationships of interdependence.

Despite the fact that Pfeffer and Salancik's theory primarily focuses on the inter-organisational level of analysis and the dynamics between organisations and their environments, its impact on studies with an intra-organisational focus is also evident. For instance, the literature on '*resource allocation*' (e.g. Case and Shane 1998; Capron, Dussauge and Mitchell 1998; Mamaghani 1999) suggests that the scarcity of organisational resources has triggered organisations to prioritise and implement their activities based on the objective measurement of the potential benefits and risks related to their activities. The phenomena of resource dependence and competition for crucial resources between organisational units are particularly apparent in the project-based organisation (Gunz and Pearson 1979). The following section highlights the current discussion relating to cross-functional project teams.

2.2.7.3 Cross-functional Project Teams

The popularity of employing cross-functional project teams for complex organisational tasks is clear in current management studies (e.g. De Meyer 1998; Turner and Keegan 1999). It is evident that organisations use cross-functional project teams for various purposes, including new product development (Clark and Fujimoto 1991), decision making (Bishop 1999) and implementing change projects (Hutt, Walker and Frankwick 1995). The rationale behind this choice is threefold. First, it aims to pool together a wide range of expertise from various organisational units to accomplish tasks which cannot easily be dealt with by one unit, thereby effectively accessing vital information and knowledge which is often concealed by functional boundaries (Henke, Krachenberg and Lyons 1993). For instance, this is demonstrated in the management of new product development projects, which often involve various organisational units such as R&D, marketing, engineering and manufacturing (Carlson and Lundqvist 1995; Clark and Fujimoto 1991).

Secondly, the aim is to obtain sufficient support from the 'stakeholders' by having representatives from various units participate in the project (Steensma and Tetteroo 2000). The importance of having organisation-wide representation and gaining sufficient support is reflected in the study by Hutt, Walker and Frankwick (1995), who argue that political hurdles are often more difficult to overcome than technological ones in the context of strategic change. Thirdly, the aim is to enhance the quality of decision making by decentralising the decision-making processes (Henke et al. 1993) and by removing functional barriers (Bishop 1999).

2.2.7.3.1 Cross-functional Project Teams as Loosely Coupled Systems

According to the theory of loosely coupled systems (Glassman 1973; Orton and Weick 1990), it is clear that the characteristics of 'distinctiveness' and 'responsiveness' are to be found in cross-functional project teams. Distinctiveness is reflected in the way in which project team members are selected. The importance of functional representation (Henke, et al. 1993) expresses the dominant norm that team members should be selected from virtually every organisational unit. This norm is also supported by the rationale of having members with complementary skills by selecting them from various functions (Katzenback and Smith 1993). Furthermore, the distinctiveness of a cross-functional project team can also be found in the social identities represented by its members (Bishop 1999). In terms of responsiveness, team members are held together by project objectives (Katzenback and Smith 1993; Tippet and Peters 1995), project ownership (Bishop 1999) and knowledge sharing (Walz, Elam and Curtis 1993).

2.2.7.3.2 The Concept of Virtual Team

In spite of fruitful findings in the study of cross-functional project teams, physical distance has commonly been neglected by these studies. This can be of particular importance when cross-functional project teams are formed of members who are dispersed across various locations. Consequently, as a result of the improved availability of information and communication technology (ICT), in particular the use of Intranet and groupware, organisations are gradually adopting virtual teamwork as an alternative means of organising their global workforces (Ciborra and Suetens 1996). A virtual team, as Morgan (1997) defines, is one whose *'team members are spread geographically, using electronic technology and occasional face-to-face meetings to integrate their*

activities' (p.52). Virtual teamwork is demonstrably an effective approach not only from the viewpoint of cutting costs (Wilson 1994) and increasing productivity (Haywood 1998), but also in terms of its ability to synthesise globally dispersed expertise (Townsend, DeMarie and Hendrickson 1998). Despite the promising advantages of virtual teams, the theoretical development of the concept, with supporting empirical evidence, remains limited (Jarvenpaa, Knoll and Leidner 1998), in particular in relation to the concept of knowledge integration. Accordingly, this study seeks to incorporate the issue of virtual teamwork into the examination of knowledge integration.

2.2.7.4 Emerging Issues

Since one of the fundamental roles of the organisation is to differentiate and integrate knowledge (Demsetz 19991; Lawrence and Lorsch 1967; Grant 1966), the dynamics underlying cross-functional project team's activities are clearly very important in this respect. However, the issue of knowledge integration within cross-functional project teams has generally been neglected in the literature. In particular, the relationship between distinctiveness and responsiveness, as highlighted by the theory of loosely coupled systems, needs to be brought into the examination of knowledge integration. Resource dependence theory (Pfeffer and Salancik 1978) reveals that due to the need for resources and co-ordination and interaction with different systems, the integration of knowledge is no longer restricted by the team boundary. This pinpoints the need to take into account the interaction between the project team and the rest of the organisation when examining the issue of knowledge integration. Furthermore, the dispersion of organisational units and project team members points to the importance of considering the influence of physical distance on the processes of knowledge integration.

2.3 Knowledge-related Activities

2.3.1 Introduction

The three key aspects of the importance of knowledge -- societal, economic and strategic -- all contribute to our understanding not only of the impact of knowledge on organisations, but also our awareness in relation to the existence of knowledge that is often taken for granted. Increasing interest in these three perspectives has led to further efforts to investigate the concept of organisational knowledge, for example through building typologies of knowledge and identifying the main characteristics of knowledge. Although valuable, these efforts have not provided a complete understanding of the full complexity of the dynamics of organisational knowledge. Gradually, more interest is being shown in the activities that enable organisational members to know what they need to know, and in the issues that influence such activities. These phenomena may be termed knowledge-related activities. The next section discusses some central concepts related to these activities.

2.3.2 Knowledge Creation

Despite the fact that organisations are constantly engaging in the activity of creating knowledge, either through combing existing knowledge or by new invention (Nahapiet and Ghoshal 1998), it is only recently that the theoretical development of knowledge creation has produced some positive outcomes. However, prior to the conceptualisation of knowledge creation theory, product and process innovation studies did reveal a

number of valuable insights. Before discussing the debates on knowledge creation in detail, several concerns raised by these early innovation studies are examined.

2.3.2.1 The Early Analysis of Knowledge Creation: Product and Process Innovation

Early innovation research focused on a number of important issues, especially the relationship between innovation and competitive advantage, the innovation process and enablers of innovation. The strategic importance of innovation lies in its role in organisational sustainability, in particular in the context of a rapidly changing environment (Kessler and Chakrabarti 1996). However, some analysts argue that product innovation alone is not sufficient to sustain competitive advantage. The study by Wheelwright (1985) suggests that a joint effort by manufacturing and R&D not only improves product innovation but also enables process innovation, and that this in turn further facilitates cost reduction. Competitive advantages are therefore gained based on the synthesis of these two types of innovation. The argument here reflects the focus within strategic management studies on the essence of knowledge, as explained earlier.

The concern with the implications of innovation in relation to competitive advantage has gradually become critical for an understanding of both the mechanisms and efficiency of innovation. Clark and Guy (1998) argue that the conventional sequential model, which sees the innovation process as consisting of '*technology push*' and '*demand pull*' components, is gradually being replaced by an '*interactive model*' that focuses on the close synergy between various R&D systems. Recognising the unique communication needs for innovation within the network organisation, Bush and Frohman (1991) state that the conventional vertical flow of communication has discouraged and blocked the

interaction of functional specialists. These authors argue that their '*concurrent model*' spurs interactive communication and learning between functional specialists. With a focus on the essence of communication and interaction, Nonaka (1990) depicts the dynamics of innovation as follows:

> '*Innovation is a product of the interaction between necessity and chance, order and disorder, continuity and discontinuity. Innovation is the result not only of the planned allocation of resources to meet some predetermined clear objective, but also of some difficult to predict or duplicate redundancy, chance, uncertainty, or even chaos.*' (p. 27)

According to Nonaka, the overlapping nature of the innovation process between various phases is one of the most vital issues contributing to the success of innovation in Japanese organisations. Such an overlap can only be achieved through the redundancy of knowledge between various functional specialists. The concept of knowledge redundancy is particularly beneficial in solving the debate on the relation between diversity of knowledge and innovation success. Some innovation scholars argue that a broad diversity of knowledge helps to stimulate the generation of different insights, thereby contributing further to the success of innovation (Campbell 1985; Combs 1993; Galunic and Rodan 1998). However, it is also suggested that the diversity of knowledge increases the complexity of communication, and that this hampers the efficiency of the decision-making process in trying to achieve consensus amongst group members (Hart, Boroush, Enk and Hornick 1985). This suggests that the creation of knowledge

redundancy in achieving collective understanding is equally essential to innovation success and group decision-making (Fiol 1994).

2.3.2.2 The Main Contributions of Innovation Studies

Insights derived from innovation studies have contributed much to the conceptualisation of organisational knowledge and knowledge-related activities. First, innovation studies have highlighted the importance of communication and interaction in achieving innovation success, particularly in the cross-functional context (Henke, Krachenberg and Lyons 1993; Pinto and Pinto 1990). Another two interrelated issues raised by innovation scholars are the role of knowledge diversity in relation to innovation success (Denison, Hart and Kahn 1996), especially in terms of the creation of knowledge (Nonaka and Takeuchi 1995), and the essential role of knowledge integration in the innovation process (Hauptman and Hirji 1999). It is important to recognise, however, that the value of knowledge diversity is not unconditional and universal. Shaw and Barrett-Power (1998), for example, show that a group's cultural background diversity in relation to processes and performance is conditional. The relationship is influenced by various issues, including detectable and underlying personal attributes, paradigm dissimilarity, cognitive cost and rewards, diversity management skills, group behavioural integration and cognitive performance resources. Finally, theories generated by the innovation discipline have formed part of the foundation for the inquiry into knowledge creation.

2.3.2.3 Knowledge Creation Theories

Rooted in and influenced by the innovation tradition, research into knowledge creation represents a distinctive focus that investigates knowledge in its own right, and an

evolutionary perspective that regards knowledge creation as the focal point of innovation activities. Based on empirical evidence from Japanese firms, Nonaka and Takeuchi (1995) indicate that knowledge is created through the dynamic interaction and conversion between tacit and explicit knowledge. According to them, knowledge creation consists of four processes: socialisation, externalisation, combination and internalisation. Socialisation is defined as '*a process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills*' (ibid., p. 62). Two crucial issues underlying this process are social interaction and shared experience. Social interaction, either formal or informal, is required so that individuals and groups can exchange what they know and learn from each other. Such interaction can only be fruitful when the involved parties have a certain degree of shared experience and understanding of the discussed subject, or '*knowledge redundancy*' as previously discussed.

Externalisation represents '*a process of articulating tacit knowledge into explicit concepts*' (ibid., p. 64). The process of externalisation involves the use of metaphors or models to represent thoughts or ideas that are otherwise difficult to communicate. Combination refers to '*a process of systemising concepts into a knowledge system*' (ibid., p. 67). The combination process, like the socialisation process, requires social interaction for exchanging knowledge. It also requires the reconfiguration of existing explicit knowledge that is unique to other processes. Internalisation is '*a process of embodying explicit knowledge into tacit knowledge*' (ibid., p. 69). Explicit knowledge can be embodied when individuals '*re-experience*' the experiences of others who created

such knowledge. At the same time, individuals can also internalise such knowledge through the experience of doing: this is the concept of '*learning-by-doing*' (Pavitt 1991).

As indicated by Nonaka and Takeuchi (1995), knowledge is created through the continuous interaction between tacit and explicit knowledge. More specifically, knowledge is created through the ongoing conversion from socialisation, externalisation and combination to internalisation in a spiral shape. These four processes depict not only how individuals create knowledge, but also how knowledge is created collectively at the group, organisational and inter-organisational levels. Nonaka and Takeuchi give the example of how Japanese firms synthesise various sources of knowledge not only from R&D, marketing and engineering, but also from suppliers, manufacturers and customers. The contributions of the knowledge creation theory proposed by Nonaka and Takeuchi are threefold. First, it represents one of the first attempts to theorise processes of knowledge creation at both the individual and collective levels. Secondly, the authors identify the conditions that enable the process of knowledge creation. Finally, the theory incorporates the dynamics of organisational knowledge with social interaction, and reveals the socially constructed nature of knowledge creation that is seldom articulated in innovation research. However, the theory raises the question of whether insights from Japanese firms can be applied to Western organisations, since organisational knowledge, Nonaka and Takeuchi argue, is context dependent and knowledge creation is socially constructed.

Another theory, proposed by Moran and Ghoshal (1996; cited in Nahapiet and Ghoshal 1998), presents a comparatively simple version of the concept of knowledge creation.

The two building blocks of their theory are the processes of combination and exchange. As explained by Nahapiet and Ghoshal, the combination process contains two components: incremental and radical. Knowledge can be created through both the incremental change of existing knowledge and radical change. Concepts such as paradigmatic change (Kuhn 1970), double-loop learning (Argyris and Schön 1978), and generative learning (Senge 1990) all represent the radical approach to combination. As Nahapiet and Ghoshal (1998) observe:

> *'There appears to be a consensus that both types of knowledge creation involve making new combinations -- incrementally or radically -- either by combining elements previously unconnected or by developing novel ways of combining elements previously associated.'* (p. 248).

In terms of the exchange process, knowledge creation requires social interaction between the parties who possess the knowledge. Through social interaction and negotiation, explicit knowledge can be transferred, and tacit knowledge can be learnt through shared experiences and understanding.

In comparison with the theory proposed by Nonaka and Takeuchi (1995), the theoretical model of combination-exchange is less detailed and sophisticated. Incontestably, many elements of the combination-exchange theory overlap with the previous theory of Nonaka and Takeuchi, e.g. in terms of the role combination plays in the knowledge creation process, and the importance of social interaction in determining processes of exchange. However, the explanation of the two combination approaches has extended

the conceptualisation of knowledge creation beyond the framework suggested by Nonaka and Takeuchi.

2.3.2.4 Enablers for Organisational Knowledge Creation

Several authors have concentrated on the enablers of knowledge creation. Nonaka and Takeuchi (1995) propose five enabling conditions: intention, autonomy, fluctuation and creative chaos, redundancy, and requisite variety. Von Krogh (1998) uses the concept of care to refer to the constructive and helpful relations between organisational members, and elaborates the importance of care by stating that '*effective knowledge creation puts particular demands on the way people relate to each other in a company*' (p.136). The concept of '*Ba*', defined by Nonaka and Konno (1998) as '*a shared space that serves as a foundation for knowledge creation*' (p. 40), refers to the context in which knowledge is embedded. As an extension of the knowledge creation theory proposed by Nonaka and Takeuchi (1995), four types of Ba, namely '*originating*', '*interacting*', '*cyber*' and '*exercising*', provide the shared spaces for organisational knowledge creation.

Regarding the employment of the workforce, Matusik and Hill (1998) suggest that contingent workers serve as a vital source for stimulating knowledge creation. Contingent workers, also termed as 'contractors' in practice, enable more rapid dissemination of knowledge into the organisation from the external market rather than from a process of internal creation. However, the use of contingent work also leads to certain disadvantages. For example, when contractors leave the organisation, this can lead to an unrecoverable '*knowledge loss*' for the organisation. In addition to the various

enablers proposed by scholars, the role of knowledge sharing in relation to knowledge creation is incontestable.

2.3.3 Knowledge Sharing

2.3.3.1 Viewpoints and Contributions of Innovation Research

In addition to the issue of knowledge creation, knowledge sharing activity is another vital matter addressed in innovation research. The primary focus is on how knowledge sharing between business functions, mainly R&D, marketing and production, contributes to successful innovation (Cooper 1988; Moenaert and Souder 1990; Souder 1997, 1988). In order to achieve such success, some of the innovation scholars suggest that it is vital to make knowledge available to all the involved parties, either through the use of groupware (Ciborra and Patriotta 1996), or by reducing departmental barriers (Rochford and Rudelius 1992), or through job rotation (Harryson 1997). The amount of knowledge and information disseminated across the involved parties determines the quality of communication, and this in turn affects the success or failure of innovation (Galbraith 1994). By pooling the expertise and knowledge of various departments, knowledge sharing enables organisations to reduce uncertainties and to achieve synthesised benefits that exceed the sum of benefits produced by departments individually (Clark and Fujimoto 1991; Wheelwright and Clark 1992; Henderson 1994). As Moenaert and Sounder (1990) point out, through the collaboration and knowledge sharing between marketing and R&D functions, the organisation as a whole is able to reduce consumer, technological, competitive and resource uncertainties. These uncertainties cannot be reduced simply by the knowledge held by one function alone.

2.3.3.2 The Theoretical Assumptions of Innovation Research

It is apparent from the above discussion that the information-processing mode of thinking has dominated the formation of the theoretical assumptions that underlie numerous innovation and organisational memory studies. With their emphasis on organisation efficiency, the information-processing system theorists (e.g. Galbraith 1977; Lawrence and Lorsch 1967; Thompson 1967) and their derivatives argue that organisations can be considered as systems that make sense of internal and external information. Similar to the perspective of strategic management research, innovation research commonly perceives knowledge as a commodity that can be acquired, transferred and utilised without taking into account its socially embedded nature, collective construction and context.

From the viewpoint of information-process theory, it is clear that organisational efficiency resides in the effectiveness of how information is gathered, disseminated, communicated and used. In particular, the information processing theorists are concerned with how information is disseminated to the maximum targeted audiences in the minimum time, as well as how various channels can facilitate the communication process. Giving very little concern to the nature of knowledge, they have failed to take into account that not every type of knowledge can be processed and communicated employing the same approach. For instance, as Figure 2.1 indicates, explicit knowledge (individual and collective) can be transferred by electronic mail. By contrast, tacit knowledge (private and public) requires a degree of face-to-face interaction.

More importantly, some of the information processing theorists have neglected the fact that the interpretation of knowledge is not universal and unproblematic (Habermas 1987). They assume that information or knowledge communicated through the formal communication channel has a fixed meaning between the sender and the receiver. Unsurprisingly, they also assume that a universal method of interpretation can and should be achieved if both parties have the same message with the same content. Given the previous discussion of the nature of knowledge, it cannot be doubted that knowledge is socially constructed (Berger and Luckmann 1967) and is context dependent (Nonaka and Konno 1998). Without taking into account the context within which knowledge is constructed and embedded, a shared understanding cannot be achieved unproblematically and automatically.

2.3.3.3 Knowledge Sharing from the Virtual Team Aspect

Issues related to knowledge sharing are of central concern to the examination of virtual teamwork. Numerous advocates argue that the use of groupware enables organisational members to share information and knowledge effectively without the constraints of time and geographic distance (Warkentin, Sayeed and Hightower 1997; Wilson 1994). Alternative working arrangements are gradually becoming more popular with the advancement and networking of information and communication technology (Hedberg, Dahlgren, Hansson and Olve 1994). The implementation of virtual teams and teleworking (Fairweather 1999; Teo, Lim, and Wai 1998) are two of the best known examples. In spite of the abundant advantages organisations stand to gain from adopting such arrangements, there is an anxiety that knowledge sharing activities might be

undermined as face-to-face interaction is replaced by electronic forms (Warkentin, *et al.* 1997).

In particular, the critical elements that enable knowledge sharing -- e.g. trust -- are not as easy to nurture in the virtual organisation (Handy 1995). Furthermore, the socially embedded nature of organisational knowledge, particularly tacit knowledge, raises the question of whether such knowledge can be shared effectively through email or video-conferencing systems. In their empirical study of the use of groupware in a new product development team with dispersed members in various geographic regions, Ciborra and Patriotta (1996) show that misunderstandings and breakdowns in the knowledge sharing process often occur due to the users' cultural differences rather than because of the system itself. However, it has been observed by Ciborra and Patriotta that the mismatch between the logic of the system and pre-existing work practice is one of the major causes of resistance to the use of a new tool. One of the major contributions made by IT and IS studies (e.g. Ciborra and Patriotta 1996; Pawar and Sharifi 1997; Walz, *et al.* 1993) is to highlight the limitations of ICT in sharing tacit knowledge and the importance of face-to-face interaction in the sharing activity.

2.3.3.4 The Emergence of a Different Viewpoint

One reason why the dominance of the information processing school in mainstream innovation studies has been challenged is that there has been an increasing awareness of the dynamic nature of organisational knowledge, in particular within the process of knowledge creation and sharing. In order to avoid the pitfalls inherited from the information processing theory, scholars have gradually altered their foci from the

efficiency of communication to the content of communication, particularly in terms of the social embeddedness of organisational knowledge (Brown and Duguid 1991; Lave and Wenger 1991; Nonaka 1994). The socially embedded nature of knowledge in relation to knowledge sharing in the context of cross-border collaborative work is examined by Lam (1997). By investigating global co-operative ventures, Lam depicts the different models of organisational knowledge employed by Japanese and British firms. Her analysis reveals how different forms of knowledge construction and focus, affect the sharing processes. According to her research, knowledge embedded in Japanese firms is based on a form of tacit knowledge derived from past experiences, and that that is different from the rationality embraced by British firms. She explains that problems occur in global co-operative ventures not only because of the tacit nature of knowledge, but also because of the way in which knowledge is structured, utilised, transferred and shared. The differences in terms of the nature, construction and organisation of knowledge, impedes knowledge sharing between the Japanese and British firms.

2.3.3.5 The Viewpoint of the Present Study

In addition to stressing the importance of having knowledge redundancy (Nonaka 1990) and common knowledge (Demsetz 1991) to enable knowledge sharing, there are other organisational issues that must be highlighted. As indicated in the earlier discussion of the control mechanism attached to the management of organisational memory, it is clear that knowledge constructed by groups or departments is often embedded within, and inevitably 'protected' by, invisible boundaries (Denison, Hart and Kahn 1996). For

knowledge sharing or acquisition to occur, it is vital to remove such boundaries to allow the necessary social interaction to take place.

However, a knowledge sharing activity is not simply an exchange of information or explicit knowledge, e.g. through documents, manuals or plans, as some innovation scholars suggest. Nor is it merely the activity of '*boundary spanning*', as described by Ito and Peterson (1986). It relies on achieving a shared understanding of the underlying knowledge, not just in terms of the content but also the context of the knowledge, or 'Ba' in Nonaka and Konno's (1998) term. Cognitively, knowledge sharing requires the understanding of the paradigms pursued by other individuals or communities. Scholars such as Boland and Tenkasi (1995) and Krauss and Fussell (1991) label such an activity as '*perspective taking*'. Sessa (1996) defines perspective taking as '*the cognitive process of understanding how another person thinks and feels about the situation and why they are behaving as they are*' (p. 105). This suggests that the exchange of information represents only a very partial view of the knowledge sharing activity. The essence of knowledge sharing lies in unveiling and synthesising paradigmatic differences through social interaction.

It must also be stressed that there is a certain theoretical ambiguity in the regularly used term '*paradigm shifting*', which refers to a change of the fundamental mode of thinking and mental model (Bush and Dooley 1992; Chia 1996). However, Kuhn's (1970) analysis raises the question of how easy or difficult it is to change a paradigm. If it were easy to shift a paradigm, then there would presumably be frequent scientific revolutions. For this reason, this study argues that concepts such as '*perspective taking*' and

'*perspective making*' are more appropriate terms for describing how paradigmatic differences between individuals or groups can be settled and managed, and explaining how shared understanding can take place. Furthermore, Boland and Tenkasi (1995) argue that mutual learning and knowledge integration are the two primary mechanisms for perspective taking. In their view, mutual learning serves as the vehicle for understanding the other party's perspective, and integration is a means for synthesising paradigmatic difference. One fundamental question that remains is: who offers their perspectives for others to take, and under what conditions. This question represents a major theoretical gap in the concept of perspective taking.

2.3.4 Collective Learning

In addition to knowledge creation and knowledge sharing, learning is a vitally important knowledge-related activity that has been subject to intensive study. Traditionally, the concept of learning is used to denote education or training. On the other hand, it is often considered as a vital process for knowledge acquisition (Huber 1991). The importance of learning in association with education and training is indisputable. However, these three areas represent distinct theoretical conceptions and applications, and it is essential to understand their differences. Jones and Hendry (1994) provide an interesting formula to depict their interrelationships: learning is equal to education plus training. It is beyond the scope of this research to provide an overview of the theories of both education and training. The concept of learning is more central to the concerns of the present analysis. It has been applied to various levels of analysis including individuals, groups, organisations and the populations of organisations (Miner and Mezias 1996). For the sake of convenience, this research adapts Dodgson's (1993) term '*collective learning*' to

represent learning that takes place at the team/group and organisational levels. The following discussion will illustrate learning at the individual and collective levels. In addition, a new perspective on collective learning will be introduced.

2.3.4.1 Individual Learning

Individual learning has a long history rooted in psychological research in the form of laboratory experiments on individuals and animals such as rats and pigeons. Classical learning theory indicates that learning, based on a stimulus-response model, is the change of response behaviour when faced with the same stimulus (Skinner 1953; Weick 1991). From the perspective of cognitive psychology, learning is the change of knowledge and experience for problem solving, rather than the change of behavioural response (Newell and Simon 1972). Behavioural and cognitive learning theories form the two major foundations for learning research, both have had notable impacts on the study of collective learning (Miner and Mezias 1996; Shrivastava 1983). Social learning theory (Bandura 1977), based on the assumption that environmental contingencies have a significant impact on guiding human behaviour, stresses that individuals learn from models, understand the consequences of action through observing models, and then enact.

For Bandura, observation and reinforcement are the two most important mechanisms which catalyse the learning process. The relationship between a modelled event and a related behaviour is facilitated by four processes: attention, retention, production and motivation. The theory of '*experiential learning*' (Kolb and Fry 1975), which combines both cognitive psychology and group dynamics, indicates that learning within a group is

an '*integrated cognitive and socio-emotional process*' (p. 34). They argue that these processes begin with (1) here-and-now experience followed by (2) the collection of data and observations about that experience. The data are then (3) analysed, and the conclusions of this analysis are fed back to the actors for use in the (4) modification of their behaviour and choice of new experience (pp. 33-4). Each process within the cycle determines one of the learner's learning abilities, learners thus need these four abilities to be effective at learning.

Additionally, the difference in learning abilities points to differences in individual learning style. The major contribution made by social learning theory and experiential learning is that they take into account the influence of the social context on the learning process. This is different from classical learning theory and Newell and Simon's (1972) concept of knowledge change, which view learning in isolation from its context. The influence of these two schools of thought -- social learning theory and experiential learning -- is also apparent in the formation of the theoretical assumptions underlying collective learning studies. Despite their efforts, individual learning theories provide very little explanation of the situation in which learning takes place in a collective form, and of how the collective learning of a group of individuals differs from the aggregation of individual learning.

2.3.4.2 Collective Learning

Theorists of collective learning are primarily concerned with the significance of learning as a source for improving efficiency, innovation and productivity through the acquisition and utilisation of knowledge, and the reflection of past experience (Argote, Beckman

and Epple 1990; Arrow 1962; Cyert and March 1963; Garvin 1993; Levitt and March 1988; McBain and Kusy 1997; Nonaka and Takeuchi 1995). Collective learning is also considered as one of the vital forces for the transformation and transfiguration of organisations (Jones and Hendry 1994). Recently, the study of collective learning has been extended to the issue of how a learning organisation (Jones and Hendry 1994; Garvin 1993; Senge 1990) or learning company (Pedler, Burgoyne and Boydell 1991) can be built. Based on a commonly held assumption that 'the whole is greater than the sum of individuals', learning theorists indicate that an organisation can only benefit from the outcome when the learning effort is made collectively (Hedberg 1982; Schein 1996; Senge 1990). Cyert and March (1963) note that, according to the trial-and-error model of behaviour and the identification of environmental change, firms adapt over time on the basis of their experience; and they term such behaviour '*organisational learning*'.

In this respect, learning curve research has also made a contribution to the conceptualisation of collective learning. The learning curve concept is similar to Cyert and March's (1963) notion of the gradually adaptive behaviour of the organisation. However, learning curve theory is centrally concerned with the quantitative outcomes of production as well as the reduction of production time and cost, without considering individual differences, group dynamics, or motivation issues. Cyert and March focus on both internal and external environmental change and the process by which firms learn to cope with change -- which is a neglected issue in learning curve research.

The concept of organisational learning suggested by these authors is reflected in the open system theories (Gresov and Drazin 1997; Toffler 1992) discussed earlier.

Although there is general scholarly agreement on the benefits and ultimate goals of collective learning, there is disagreement about the route that leads to these outcomes. This debate is particularly apparent in the study of learning processes, where it argued that the understanding of outcomes is insufficient to articulate the insights arising during the learning process (Boisot 1995; Boisot, Griffiths and Moles 1997; Cohen and Sproull 1996; Dodgson 1993; Huber 1991; Jones and Hendry 1994; Kasl, Marsick and Dechant 1997; Kolb 1984; Kolb and Fry 1975). This point has its roots in the work of Cohen and Levinthal (1990), who indicate that learning occurs not only in the focus of R&D, but also in the process itself. The following section looks more closely at the current debate on the issue of learning processes.

2.3.4.2.1 Collective Learning Processes: Radical and Incremental Approaches

2.3.4.2.1.1 The Radical Approach to Collective Learning

One of the most influential organisational learning theories, proposed by Argyris and Schön (1978), distinguishes between '*single-loop learning*', which detects and corrects errors, and '*double-loop learning*', which refers to the restructuring of organisational norms and the changing assumptions underlying these norms. For Argyris and Schön, single-loop learning is merely a self-reinforcing trap. They believe that only double-loop learning, the radical approach, can provide real benefits to organisations, despite the fact that examples of double-loop learning are extremely rare. According to the explanation provided by Shrivastava (1983), '*organisational theories-in-use result from shared assumptions, and learning involves changes in these theories*' (p. 10). Taking further the ideas of Argyris and Schön, Senge (1990) stresses the importance of building a shared mental model amongst learners, and indicates that this helps to remove obstacles that

block generative learning. Similar findings are articulated by Gynawali, Stewart and Grant (1997), whose '*interactive learning*' concept refers to the informal process of creating shared new schema through the actions and interactions of various individuals and units in the organisation. Furthermore, McKenna (1995) argues that collective learning requires a change in attitudes as well as a change of assumptions and paradigms -- a view which overlaps with the findings of studies of paradigm shifting.

2.3.4.2.1.2 The Incremental Approach to Collective Learning

In contrast to the radical approach, several research perspectives (including the learning curve concept discussed earlier) derived from the behavioural theory of the firm, regard collective learning as an incremental process. Following the information-processing paradigm, Huber (1991) indicates that collective learning consists of four processes: knowledge acquisition, information distribution, information interpretation and organisational memory. From Huber's point of view, it is clear that collective learning takes place through the continuous accomplishment of each process. The theoretical framework provided by Huber is not concerned with changes in attitudes or in the mental model (as emphasised by the radical approach theorists), but seeks to ensure that information is made available to organisational members, and that the sharing and communicating of such information is efficient. His emphasis on the acquisition and dissemination of knowledge is shared by some of the technology diffusion and innovation studies, particularly those based on the information-processing paradigm.

However, Huber takes into account the importance of information interpretation, which is generally ignored by the classical information processing scholars. The essence of

organisational memory in relation to collective learning is explicated by his seminal work. Providing a descriptive account, Sashkin and Franklin (1993) suggest that there are three approaches to enhancing collective learning: crisis problem solving, learning for the improvement of current activities, and anticipatory learning. The observation of informal learning made by Marsick and Watkins (1997) indicates that learning does not always occur as organisations intend, and is often informal and even incidental. As Miles and Randolph (1980) argue, collective learning can take place reactively or proactively. However, organisations develop gradually through the continuous accumulation of knowledge, and the learning style has a significant impact on this development process.

March (1991) offers a synthetic account that incorporates both approaches and the social context into the discussion of collective learning. In his view, collective learning is composed of two elements: exploitation and exploration. Extending the behavioural theory of the firm, March notes that '*a central concern of studies of adaptive processes is the relation between the exploration of new possibilities and the exploitation of old certainties*' (p: 71). The concept of '*mutual learning*' proposed by March seeks to show how individuals learn organisational norms, working procedures and the trade-off between exploitation and exploration through the socialisation process. On the other hand, organisations learn by recruiting new members and adapting to individual beliefs. March's concept of mutual learning is different from that of Boland and Tenkasi (1995). According to the former, learning takes place between the organisation and its members, and the approach can be radical or incremental. According to the latter, learning occurs

at the individual level and the approach is radical because of the need to modify the individual's perspective.

Despite the fruitful insights articulated by collective learning research, it is not very clear from the current literature how the nature of collective learning differs from that of individual learning. The rationale behind this mystery is threefold. First, it reflects an ongoing debate about whether or not an organisation, as an independent identify, can learn. Scholars such as Dodgson (1993), Hedberg (1982) and Simon (1991) argue that organisations do not learn; only individuals on behalf of the organisation can do so, and the aggregation of individuals contributes to the organisation. Referring to the earlier discussion of Hutchins' (1991) work, it is clear that collective learning demonstrates a synthesis that is distinct from the aggregation of individual learning.

Secondly, the lack of methodological and theoretical rigour also leads to the ambiguity of the collective learning concept. The common use of the individual learning metaphor to study collective learning, and the employment of individual learning theories to explain collective learning phenomena have inevitably failed to escape from the conceptual trap of the individual learning paradigm. It is not surprising that the collective learning concept, as used by many authors, is merely a collection or an aggregation of individual learning. Finally, the detachment of the organisational context from the inquiry into collective learning processes also causes confusion between the individual and collective learning concepts. Such a separation fails not only to take into account the impact of organisational context upon the learning process, but also to

recognise that collective learning might be different at the team, group and organisational levels.

2.3.4.2.2 An Alternative Perspective: The Concept of Situated Learning

An emerging school of thought, termed situated learning, provides a new perspective on examining and depicting the collective learning concept. The concept of situated learning, as presented by Lave and Wenger (1991), refers to '*an integral part of generative social practice in the lived-in world*' (p. 35). Moving away from the radical-incremental debates, Lave and Wenger extend the line of argument by incorporating the learner's socialisation process into the discussion of collective learning. According to them, the first step for a newcomer to learn within a community of practitioners is to acquire his/her '*community membership*' (Brown and Duguid 1991). Lave and Wenger (1991) term the characteristic of this social activity '*legitimate peripheral participation*'. They indicate that '*learning is never simply a matter of the "transmission" of knowledge or the "acquisition" of skill*' (p. 116). They see learning as taking place through participation, facilitated by the differences of perspective among the community members.

More importantly, learning, with its socially situated character, is distributed across the community. Building upon the insights of Lave and Wenger, Brown (1991), Brown and Duguid (1991) and Orr (1990) have advanced the understanding of the concept of 'community of practice'. Brown (1991) provides a detailed account of how a group of technicians at Xerox learn as a community through an informal method of storytelling. Brown shows that, despite the numerous descriptions in operational manuals,

technicians often face novel problems that cannot be solved simply by consulting the instructions. By sharing narratives of the past experience within the community, technicians are able to pick up stories on how to solve problems. More importantly, Brown also points out the gap between what and how the organisation expects employees to learn and what and how employees actually do learn.

One of the major contributions made by the situated learning theorists is their explanation of the interrelationships between the learning process, the social context and the dynamics of both elements, particularly in the context of a community. Secondly, the notion of legitimate peripheral participation, suggested by Lave and Wenger (1991), challenges the traditional assumption rooted in the learning literature that every learner has an equal social influence on the learning process. Thirdly, the 'community of practice' concept provides an alternative avenue to examine knowledge-related activities by incorporating a socially situated characteristic. Additionally, the concept helps to break down the conventionally held assumption that organisations are the principle learning entities in inquiring collective learning. Without recognising and investigating how subunits within the organisation learn, conventional thought runs the risk of using only a partial view to represent the whole picture of collective learning.

However, several limitations of the situated learning concept are also evident. First, the existence of a community is taken for granted by the situated learning theorists. In other words, they do not provide any explanation of how a community is formed in the first place. Secondly, those who advocate a 'community of practice' have failed to extend further the concept of situated learning by providing an explanation of how the

interaction between different communities takes place, how that interaction might affect the way in which community members learn, and how one community can learn from another. Thirdly, there is a failure to explain how situated learning influences the change of organisational knowledge and organisational memory dispersed and embedded in the social context.

2.3.4.2.3 The Standpoint of the Present Study

From the above discussion, it is clear that the acquisition of knowledge serves explicitly or implicitly as one of the ultimate goals for collective learning, even though the approach taken varies. This study acknowledges the radical approach's emphasis on the significance of a fundamental assumption change in triggering the generation of new knowledge. It also sees collective learning as an ongoing process that takes place through continuous adoption and absorption, as argued by supporters of the incremental approach. As Miner and Mezias (1996) comment, the two approaches, although derived from different theoretical assumptions, are equally essential for understanding the collective learning concept. This view is expressed by March (1991), who focuses on the relation between exploitation and exploration in collective learning.

This study agrees with the argument of Miner and Mezias (1996) that it is also critical to incorporate the social context into the examination of collective learning, as advocated by the situated learning school. As Dodgson (1993) observes, collective learning is dynamic and develops according to existing ways of doing things, and present know-how and routines. Learners, no matter whether they are individuals, teams/groups or organisations, need existing knowledge to learn. Such knowledge, according to Fiol and

Lyles (1985), consists of the '*lessons learnt from the past*'. For Kolb (1984), it is '*past experience*'; and for Nelson and Winter (1982), it is the '*routine*' embedded within the organisation. Despite the widespread agreement about the importance of the acquisition of knowledge and its strategic significance, there are few examples that incorporate the social embeddedness and path dependent nature of knowledge into the examination of the learning process (Dosi 1982) apart from the work of Lave and Wenger (1991) and March (1991). The fact is that, as in strategic research, knowledge has often been taken for granted in the learning literature. Therefore, knowledge is often regarded as a commodity that can be understood without reference to its context (Star 1989). However, without taking into account the nature of knowledge, the collective learning theorists run the risk of not acknowledging how different types of knowledge can influence collective learning processes.

2.3.5 Knowledge Integration

Compared to the voluminous literature on knowledge creation, knowledge sharing and collective learning, the concept of knowledge integration is relatively underdeveloped, even though it has been used for the last four decades (e.g. Argote 1982; Lawrence and Lorsch 1967; Trist 1977). Accordingly, this study draws on the literature on organisational knowledge, organisational memory, knowledge-related activities and other related disciplines to form the theoretical foundation for the inquiry into knowledge integration processes. This section highlights the current theoretical development and debates in the literature of cross-functional collaboration and knowledge integration. The review draws on concepts from existing research areas to expose the similarities and differences between various schools of thought. In this way,

it seeks to provide a critical but also integrative account of the current debates and perspectives in the literature on knowledge-related activities.

The review will start with the definition of knowledge integration. Then four different perspectives will be outlined, stemming from the organisational behaviour, innovation, economics and strategy disciplines. Even though there are more perspectives can be found in the current literature, it is beyond the scope of the study to address them all. Through a synthesis of the organisational knowledge and knowledge-related activities literature, four distinctive processes of knowledge integration -- socialisation, resource securing, perspective taking and organisational memory constructing -- are highlighted. Finally, several theoretical gaps, evident in the current organisational knowledge and knowledge-related activities literature, are identified.

2.3.5.1 Definitions of Cross-functional Collaboration and Knowledge Integration

Lawrence and Lorsch (1967) define cross-functional integration as: '*the quality of the state of collaboration that exists among departments that are required to achieve unity of effort by the demands of the environment*' (p. 11). According to their argument, integration is one of the key mechanisms that enable organisations to synthesise their internal resources to cope with their external environment. Hence, it is understandable that they employ the concept of integration as the fundamental building block for organisational design. Developing the approach of Lawrence and Lorsch (1967), Moenaert and Souder (1990) refer to integration as:

> '*The symbiotic interrelating of two or more entities that results in the production of net benefits to them, with these benefits*

exceeding the sum of the net benefits they would produce in a non-symbiotic relationship.' (p. 91)

Van de Ven, Delbecq and Koenig (1976) apply the term '*co-ordination*' instead of integration, and define it as '*integrating or linking together different parts of the organisation to accomplish a collective set of tasks*' (p. 322). Tenkasi and Boland (1996) see integration as channel management and knowledge integration as perspective taking. As discussions of perspective taking reveal, knowledge integration has not only an intellectual, but also an emotional, dimension. In addition, the term integration is often associated with concepts such as collaboration (Trist 1977) and co-ordination (Argote 1982).

The above definitions suggest that cross-functional integration is a multidimensional concept composed of various attributes. However, most of the definitions focus on the benefits and outcomes of integration rather than on the conceptualisation of its processes. Furthermore, knowledge is not specifically addressed in the studies of cross-functional integration, with the exception of the work of Boland and Tenkasi (1995). Following the above discussion, this study defines knowledge integration as an ongoing collective process of synthesising distinctive knowledge and paradigms as a means of constructing new knowledge through the social interaction of organisational members.

2.3.5.2 Knowledge Integration: Perspectives from Various Research Disciplines

2.3.5.2.1 Knowledge Integration: The Organisational Behaviour Approach

Despite the fact that cross-functional or inter-departmental knowledge integration is now attracting increased attention (Galbraith 1994; Weick and Roberts 1993), the concept is still underdeveloped compared to the concepts of knowledge creation, knowledge sharing and collective learning. The study of integration within an organisational context can be traced back to the early development of organisation theories. As Lawrence and Lorsch (1967) point out, the concept of cross-functional integration has been discussed by organisation theorists such as Fayol (1949), Gulick and Urwick (1937) and Mooney (1947). One of the major contributions is that of Lawrence and Lorsch (1967), who recognise the systemic properties of organisations that were not well articulated by previous scholars. As they point out, the differentiation caused by the increasing specialisation of departmental functions, can be observed not only in segmentation and specialised knowledge, but also in cognitive and emotional orientation. That further hampers the process and efficiency of integration.

Despite the fact that knowledge is not the main focus in the work of Lawrence and Lorsch, their views have influenced many studies in organisational behaviour and other research disciplines. For example, it has inspired research into product innovation through the integration of marketing and R&D (Moenaert and Souder 1990), and the quest for competitive advantage by integrating contingent workers' knowledge with existing organisational knowledge (Matusik and Hill 1998). It has also had an impact upon the study of the integration of knowledge diversity in a knowledge-intensive firm (Tenkasi and Boland 1996), process development in pharmaceutical firms (Pisano 1994), and cross-functional communication for new product development (Pinto and Pinto 1990). Moreover, Lawrence and Lorsch's contribution on interdepartmental

communication and collaboration has helped to form the foundation of the information-processing school of thought (e.g. Galbraith 1977; Tushman and Nadler 1978).

However, although the concept of integration has been investigated intensively over five decades, the emphasis has been on understanding its implications rather than its processes. In particular, previous studies have examined the issue of integration with a primary focus on inter-group communication and collaboration. It was only recently that knowledge has been incorporated into the examination of integration, with the result that knowledge integration is now perceived as one issue rather than two isolated research agendas. At the same time, the phenomenon of organisational knowledge has gradually come to be recognised and examined in its own right. Even so, most studies of knowledge integration are based on the innovation and strategy disciplines rather than on the perspective of cross-functional project team. This is a gap which urgently needs to be filled.

2.3.5.2.2 Knowledge Integration: The Innovation Approach

Rooted in information-processing theory, innovation studies commonly perceive knowledge integration as a process that enables information sharing to take place across functions, resulting in the generation of new knowledge through the reduction of internal and external uncertainties (Cooper 1988; Moenaert and Souder 1990). It is clear that the common assumptions underpinning the study of knowledge creation and knowledge sharing are also reflected in the analysis of knowledge integration (see, e.g., Combs 1993; Galunic and Rodan 1998; Souder 1997, 1998). There are several studies that pursue different paradigms to those of the information-processing theorists. An

empirical study by Pisano (1994) indicates that variations in the structures of the underlying scientific knowledge in pharmaceutical firms influence the way in which companies learn and integrate their knowledge.

With prior scientific and practical knowledge of the products and their developments, companies are able to utilise their existing knowledge to predict the potential outcomes. That is why Pisano argues that '*learning-before-doing*' can take place outside the final use environment. In this respect, Pisano notes that '*such knowledge might be embedded in formal or informal models containing the relevant underlying variables, their interactions and their impact on outcomes*' (p. 89). In some cases, companies with very limited prior scientific knowledge would need to acquire knowledge during the experiment process in the laboratory environment. That is what Pisano means by '*learning-by-doing*' (Arrow 1962). Pisano (1994) extends his analysis of the relationship between learning and integration: '*the integration required during development projects is a microcosm of the learning processes within organisations*' (p. 98). One of the key contributions made by Pisano is to link the collective learning concept with the theoretical development of knowledge integration.

The importance of integrating customers' and suppliers' knowledge for the success of new product development is emphasised by several studies. Bozdogan, Deyst, Hoult and Lucas (1998) observe that to involve and integrate suppliers' knowledge at an early stage of the development process helps project teams to match the product features with the associated specialised skills required for future production. The match lies in the intensive sharing of knowledge between both parties and is enabled by the long-term

commitment to the supplier, co-location and joint responsibility. The integration of customer's knowledge in relation to new product development effectiveness is examined by Souder, Sherman and Davies-Cooper (1998). Based on a study of 101 new product development projects in the US and the UK, these authors suggest that the integration of knowledge between R&D and marketing and R&D and customers improves not only the effectiveness, but also the commercialisation, of R&D outcomes. However, Jassawalla and Sahittal (1998) argue that there are several critical elements that must occur if knowledge integration is to take place between marketing and R&D. These are: sharing innovation outcomes, an openness in sharing knowledge, and a willingness to participate and to accept any paradigmatic differences.

Three major points emerge from these studies. First, it is manifest that some vital knowledge required for developing new products often exists outside the organisation. Therefore, the scope of knowledge integration should not be limited to where the organisational boundary lies. Secondly, knowledge integration does not correspond, as the information-processing school of thought suggests, to the exchange and pooling of knowledge and expertise. It also involves the creation of new knowledge stemming from the synthesis of various sources of knowledge. Finally, knowledge integration is a collective social process that requires shared benefits, trust and perspective taking.

2.3.5.2.3 Knowledge Integration: The Economic and Strategic Approaches

From an economic perspective, Demsetz (1991) argues that conventional economic theories, in particular transaction cost theory, have neglected the cost of information. Even more importantly, they have dismissed the role that knowledge specialisation plays

in relation to productivity. Inspired by Stigler (1961), Demsetz (1991) argues that an '*economic organisation, including the firm, must reflect the fact that knowledge is costly to produce, maintain, and use*' (p. 171). He further adds that:

> *'Knowledge does not directly convert to utility or living standards. If each of us specialises in a single branch of knowledge but attempts to use this knowledge without relying on others, the standard of living achievable would be less than if everyone had become a jack-of-all-trades. Although knowledge can be learned more effectively in specialised fashion, its use to achieve high living standards requires that a specialist somehow use the knowledge of other specialists. This cannot be done only by learning what others know, for that would undermine gains from specialised learning. It cannot be done only by purchasing information in the form of facts, for in many cases the theory that links facts must be mastered if facts are to be put to work.'* (p. 172)

In order to achieve communication among specialists or occupational groups without involving the high cost of extensive education and training, the development of '*common knowledge*', or in Nonaka's (1991) term 'knowledge redundancy', is critical. As Demsetz (1991) observes:

> *'Because it is uneconomical to educate persons in one industry in the detailed knowledge used in another, resource*

is had to developing or encapsulating this knowledge into products or services that can be transferred between firms cheaply because the instructions needed to use them do not require in-depth knowledge.' (p. 173)

This point is reflected in Demsetz's notion of '*directions*'. In simple terms, this refers to the degree of understanding required to use certain specialised knowledge. For instance, the requirement for an understanding of specific knowledge varies among those people who generate the specialised knowledge, those who produce goods based on the knowledge, and those who consume the goods. Two of the major contributions made by Demsetz are his explanations of how knowledge can be contextualised and communicated across various user groups in relation to their needs. Secondly, the cost of knowledge, normally neglected by economists and organisational knowledge theorists, raises the vital issue that knowledge-related activities require resources such as money or time to make them happen.

With limited resources available in the organisation, it is understandable that knowledge-related activities, whether knowledge creation, knowledge sharing or knowledge integration, are prioritised according to the need for, and availability of, resources in the organisation. This leads to a series of questions about how organisations prioritise their knowledge-related activities, issues that influence the prioritising decisions, and how priorities can be maintained. Despite the novel insights provided by Demsetz, he provides very little detailed elaboration of the knowledge integration processes in the organisational context.

Developing the ideas of Demsetz (1991), Grant (1996) proposes a knowledge integration theory to show how various activities can collaborate within the organisation and why organisations exist in the first place. By examining knowledge integration within the firm as well as between firms, Grant concludes that '*the primary role of the firm, and the essence of organisational capability, is the integration of knowledge*' (p. 375). Taking further Demsetz's idea of '*direction*', Grant shows that direction and organisational routines are two primary mechanisms of knowledge integration:

> *'The essence of an organisational routine is that individuals develop sequential patterns of interaction which permit the integration of their specialised knowledge without the need for communicating that knowledge.'* (p. 379)

As Grant (1996) points out, competitive advantage does not arise from knowledge *per se*, but from the integration of such knowledge that facilitates the generation of new knowledge. He further explains that the level of common knowledge and the frequency and variability of a task performance determines the efficiency of knowledge integration. The scope of integration, in particular the diversity of specialised knowledge involved in the integration process, determines its difficulty. Hence, flexibility is vital in determining the efficiency of knowledge integration. By renewing existing patterns of knowledge integration to generate new ways, competitive advantages can be sustained. Thus, three dimensions of knowledge integration-- efficiency, scope and flexibility-- determine a firm's potential for sustainability. The major contributions made by Grant are: his recognition of the role of knowledge integration in explaining the existence of

organisation, and its essence in relation to organisational efficiency and competitive advantage. Like Demsetz (1991), Grant operates at the conceptual level, arguing for knowledge integration without the support of empirical evidence concerning the process through which knowledge is integrated.

2.3.5.2.4 Interrelationships between knowledge integration, knowledge sharing, knowledge creation and collective learning

Based on the seminal work of Nonaka and Takeuchi (1995) discussed in section 2.3.2, it is clear that the interrelated processes of knowledge creation can be employed to explain the interrelationships between the four types of knowledge-related activities. The importance of knowledge sharing is evident in the process of socialisation in which organisational members exchange ideas and thoughts from intensive social interaction. This mirrors the process of exchange argued by Nahapiet and Ghoshal (1998). Linking to the definition of individual learning suggested by Kolb and Fry (1975), the processes of externalisation and internalisation (Nonaka and Takeuchi 1995) are closely overlapped by the processes of learning in which individuals learn based on continuous acquisition of and reflection on experience.

According to the collective learning processes provided by Huber (1991), it is clear that collective learning serves as a vital mechanism to enhance knowledge creation by the acquisition and interpretation of information. Drawing on the concepts of double-loop (Argyris and Schön 1978) and generative learning (Senge 1990), the outcome of such a dramatic learning approach can be considered as a 'final product' of knowledge creation processes, that is the change of practices and mental models. From the account of

knowledge integration from an innovation approach (e.g. Cooper 1988; Pisano 1994), it is clear that knowledge integration is perceived as the underlying mechanism that enables knowledge creation through synthesising knowledge dispersed and embedded within various organisational units. Again, from Demsetz (1991) and Grant's (1996) arguments, knowledge integration is critical to knowledge creation because of its co-ordination function.

From the above discussion, it is clear that knowledge sharing, collective learning and knowledge integration are three crucial mechanisms of knowledge creation. However, by synthesising contributions from various research disciplines, it is also clear that the concept of knowledge integration should not be limited to such a narrow scope. The following discussion highlights the multi-faceted and multi-dimensional nature of knowledge integration by elaborating various interrelated processes underlying cross-functional knowledge integration activities.

2.3.5.3 The Processes of Knowledge Integration

With no available theoretical frameworks or empirical findings, this study synthesises the current literature from the perspective of various research disciplines to unveil processes of knowledge integration within the organisational context.

2.3.5.3.1 Knowledge Integration as a Socialisation Process

From the earlier discussion, it is clear that knowledge is dispersed into various subunits, as is organisational memory. The study of boundaries in the group or community context indicates that knowledge constructed by one group is often embedded within the

intangible group boundary. This point is reflected in Moorman and Miner's (1997) discussion of the accessibility of organisational memory, and Walsh and Ungson's (1991) account of the control and abuse of organisational memory. Therefore, this study argues that the dynamic flow of knowledge as described by Starbuck (1992) underestimates the boundaries surrounding organisational subunits which impede this flow. In his study of the '*knowledge-intensive firm*', Starbuck urges firms to embed their knowledge in physical capital, routines, organisational culture and social capital, and states that such representations of knowledge are reflected in what organisational members do, how they think, and why they think in a certain way. However, variations in the subunits' routines, culture and social capital demonstrate that these representations of knowledge cannot be generalised as something universal in the organisation. Neither can these artefacts be interpreted, understood and utilised by various subunits in the same way as Starbuck implies.

Two key questions emerge from the above discussion. First, what processes do organisational members need to go through before knowledge embedded within various organisational subunits can be integrated? What issues influence the social interaction of knowledge integration processes? The answers to these questions provided by Lave and Wenger (1991) is that community membership is acquired through socialising with other community members. The authors also observe that members with experience and skills serve as role models for the newcomers, who learn through processes of attention, retention, production and motivation, just as social learning theory (Bandura 1977) suggests. In addition, the conceptual framework presented by Nahapiet and Ghoshal (1998) suggests that three dimensions of social capital -- structural, cognitive and

relational -- affect the processes of exchange and combination amongst organisational members. In particular, '*network ties*' enable organisational members to access valuable resources sooner than people who are not part of the network.

2.3.5.3.2 Knowledge Integration as a Resource Securing Process

In addition to the role social interaction plays in the knowledge integration process, Demsetz (1991) highlights the cost of knowledge-related activities as another dimension for consideration. However, the general literature ignores the fact that these activities require resources to trigger, energise and sustain them. Organisations have to consider their existing resources and prioritise their knowledge-related activities. Discussions of such prioritisation focus primarily on the process by which such decisions are made (Case and Shane 1998). The underlying idea shared by this subset of the literature is to strategically allocate limited organisational resources in order to gain maximum benefits by reducing risk (Galbraith 1977) or encouraging risk taking (Case and Shane 1998).

It is clear then, that the calculation of potential benefits and risks related to business activities characterises the theoretical development of the resource allocation literature. Linking this argument to the issue of how organisations prioritise their knowledge-related activities and allocate resources to them, it seems clear that organisations must seek, as their ultimate goal, to gain maximum benefits with minimum risks from any knowledge-related activities. However, it is questionable whether there is a 'best' decision that can be made with a universal and consensual meaning for every organisational subunit. On the other hand, this argument's perception of such decision-making processes as neutral and free from the social influence of organisational

members is surely unrealistic. As Cooper (1988) and Moenaert and Souder (1990) point out, marketing, manufacturing and R&D often have very different opinions about what should be considered as the 'best' decision for new product development. Hence, it is vital to reconsider and examine how decisions in prioritising knowledge-related activities are made, why such decisions are made, and what issues influence such decisions as a basis for understanding knowledge integration processes. More importantly, in order to allow knowledge to be integrated continuously, it is necessary to understand how the process of knowledge integration can be sustained by securing the required resources.

2.3.5.3.3 Knowledge Integration as a Perspective Taking Process

The above discussion on prioritising knowledge-related activities brings out the issue of how different opinions held by various functions can be synthesised. Using Kuhn's (1970) term 'paradigm' to represent the different mental models pursed by various business functions or communities, it is manifest that knowledge integration requires a synergy of various paradigms. A study by Weick and Roberts (1993) offers useful insights into how the connections between individuals' minds form a '*collective mind*'. This term is defined as '*a pattern of heedful interrelations of actions in a social system*' (p. 357). In order to avoid accidents, some organisations are required to achieve a virtually error-free performance, as in the operation of an aircraft carrier. Reliability is the major concern of this type of organisation, and this is achieved by the seamless performance of its members. In order to achieve a constantly high level of reliability, members with different tasks and skills need to interact and collaborate as an interconnected system. The dynamics of the collective mind, according to Weick and

Roberts (1993), are '*constructed and reconstructed continually by individuals through the ongoing activities of contributing, representing, and subordinating*' (p. 365-6).

Additionally, the concept of perspective taking, as developed by Boland and Tenkasi (1995), is also useful in depicting how a paradigm is formed and reformed collectively in a 'community of knowing'. The authors argue that in order for perspective taking to proceed, community members have to externalise their unique individual knowledge and make it available to exchange with others. Even though they point out that inferential and judgmental processes can cause false consensus and breakdown, they do not actually show how the group dynamics may affect the perspective taking process. For instance, we need to know how the power distribution among community members affects the construction of perspective taking.

It is clear from the above two studies (Weick and Roberts 1993; Boland and Tenkasi 1995) that knowledge integration is a mental process that requires organisational members to encounter and confront their paradigms in order to formulate a mutually acceptable blueprint for taking actions. However, the two studies commonly assume that every individual has a similar level of influence in shaping the 'collective mind' or 'perspective', and that the social interaction amongst individuals is an apolitical phenomenon. They therefore both run the risk of not differentiating between the situation in which the perspective taking or collective mind construction process is equally shared by all members and that which is dominated by a small number of individuals. Thus, it is critical to investigate the dynamics of social interaction and to understand how they influence the construction process of perspective taking. This

understanding can then serve as a foundation for investigating the cognitive aspect of knowledge integration processes.

2.3.5.3.4. Knowledge Integration as an Organisational Memory Constructing Process

In order to understand the knowledge integration process, another need is to investigate how organisational members use the existing organisational knowledge and memory to perform their tasks and learn from those tasks. This is what Blackler (1995) calls '*knowing*'. Before this question can be answered, it is important to understand what role organisational memory plays in relation to the organisational members. Organisational memory is employed for several functions. According to Moorman and Miner (1997), two fundamental roles are interpretation -- '*filtering the way in which information and experience are categorised and sorted*' (p. 93) -- and action guidance -- '*dictating or influencing individual and group action*' (p. 93). Based on the view that organisations are interpretative systems (Daft and Weick 1984; Weick 1979), it is understood that organisational memory affects the way in which experience is interpreted. Shrivastava and Schneider (1984) term this '*organisational frame of reference*'. They suggest that the organisational frame of reference not only steers the way in which the environment is understood, but also guides the way in which decisions are made and actions are taken.

Another two critical functions of organisational memory, discussed by Walsh and Ungson (1991), are the integration of organisational knowledge and the co-ordination of activities within the organisation. This perspective is similar to that of Morgan (1995),

who uses the '*brain metaphor*' to represent organisations. This means that there is a centralised organisational framework formed by shared meanings and language. This central brain directs various organisational functions and pulls them together as a network. As Walsh and Ungson (1991) state:

> '*A facility must exist in an organisation in order to store communicable, consensual, and integrated knowledge. This knowledge integrates and co-ordinates all organisational activities -- even the transmission of new knowledge through the system. This facility, of course, is an organisation's memory.*' (p. 72)

If we consider the four roles of organisational memory discussed above, then it follows that organisational members employ their existing knowledge as a frame of reference to interpret, act and think. Additionally, individuals use organisational memory, based on their methods of interpretation, as a guide to integrate knowledge. This knowledge is then used to reshape individuals' experience, as the concept of '*experiential learning*' suggested by Kolb and Fry (1975) indicates. The integrated knowledge further serves as a means to configure the organisational memory. Hence, the process of knowledge integration can be considered as the process of organisational memory constructing, and together the two processes are interactive and mutually reinforcing.

However, differences in individuals' and subunits' knowledge inevitably create variations in the way in which phenomena are perceived and interpreted. This is reflected in the dispersion of organisational memory (Walsh and Ungson 1991) and its

variations amongst organisational subunits (Moorman and Miner 1997). Hence, it is clear that organisational memory is gradually and collectively constructed by synthesising, compromising and diminishing different interpretations between its members and subunits. Such dispersion and variation further suggest that knowledge integration processes cannot simply be understood from the organisational level alone, but must incorporate a group level of inquiry.

2.4 The Social Construction Perspective

2.4.1 The Introduction of the Social Construction Perspective

The term '*social construction*' was first used by Berger and Luckmann (1967) to refer to the way in which social reality is shaped and constituted in everyday life through the interaction between the producer (individuals) and the produced (the social world). This viewpoint mirrors what Weick (1979) calls the process of '*enactment*' and Garfinkel (1967) calls '*accomplishment*'. In the organisational context, the phenomenon of social construction is highlighted by Morgan (1997): '*organisations are in essence socially constructed realities that are as much in the minds of their members as they are in concrete structures, rules and relations*' (p. 141). One of the major contributions made by Berger and Luckmann (1967) to the sociology of knowledge is the notion that because reality is socially constructed, it can only be analysed and investigated through its evolving processes.

2.4.2 Extended Thoughts: The Social Construction of Technology and Actor-Network Theory

This approach to understanding social reality was a significant influence in the development of the sociology of scientific knowledge in the 1970s and 1980s, with its aim to move beyond previous paradigms in the study of science. Instead of focusing primarily on '*institutionalised arrangements and the norms, careers and rewards of professional scientists*' (McLoughlin 1999, p. 90), the emerging viewpoint is to focus on scientific knowledge itself (Pinch and Bijker 1987). The perspective taken by the sociology of scientific knowledge has been further extended to the study of technological knowledge by discarding technological determinism's linear model in explaining the technology development process and regarding social and technical elements as a '*seamless web*' (Bijker, Hughes and Pinch 1987; Woolgar 1991).

The relationship between these two elements is seen by Grint and Woolgar (1997) as '*a network rather than as parallel but separate systems*' (p. 10). Derived from the sociology of scientific knowledge, in particular its core concept of '*interpretative flexibility*' (Collins and Pinch 1982), the emergence of the '*social construction of technology*' (Pinch and Bijker 1987) has formed a distinctive school of thought that conceptualises the process of technological design and development. McLoughlin (1999) describes the social construction of technology (SCOT) approach as:

> '*A multidirectional process where a range of alternative design options exist and are gradually eliminated as a consensus is established by relevant social groups over what the technology is, what it can and cannot do.*' (p. 92)

Underlying the concept of SCOT is the interaction between '*relevant social groups*' (Pinch and Bijker 1987) that represent people with different paradigms in defining, perceiving and designing the technology. In Latour's (1987) terms, these groups are the '*actor-networks*' that form the '*black box*' of technology. Despite the conceptual overlap between SCOT and actor-network theory, the difference between them lies in their view of how stabilisation or consensus is achieved within the relevant social groups or actor-networks. From the SCOT perspective, the '*technical decision*' as a social process is made through interpretation and negotiation (Pinch and Bijker 1987). In contrast, Latour (1987) argues that stabilisation is achieved through changing social and technical networks. In other words, the resolution of controversial viewpoints relies on achieving the enrolment of actors who previously belonged to other networks. Based on the perspective of actor-network theory, such changes in social and technical networks may be understood as the processes of innovation.

One of the contributions made by the SCOT and actor-network theories is that they highlight the difficulty of drawing a clear line between technical and social elements in shaping technology. Therefore, opening up the 'black box' relies on investigating and understanding how actors or social group members achieve a consensus decision. Despite the fact that their approaches vary, both theories commonly seek to capture the dynamic and complex process of social interaction which is a fundamental precondition for understanding the social construction of reality.

Synthesising the social construction perspective with Nadel's (1957) theory of social structure, Barley (1990) investigates the alignment of technology and organisational

structure change. Examining the micro-social dynamics through which technologies affect the structure of organisations, Barley indicates that '*it is difficult to see how any social structure can be produced and reproduced except through ongoing action and interaction*' (p. 64). Similar views are also expressed in the work of Collins (1981) and Giddens (1984). More importantly, Barley points out contingency theory's '*primarily static*' vision, its oversimplified postulation of a direct link between technology and structure, and its ignorance of the issues of human actions in relation to this dynamic change process.

Lazega (1992) adds the political dimension to the conceptualisation of social construction in workgroups. In particular, he focuses on the evaluation of information, an issue that is not fully articulated by the social constructionists. Lazega argues that Berger and Luckmann (1967) take the information value of a message for granted, and that the process of evaluating information is greatly affected by the perceived authoritativeness of the source of information. As indicated by Lazega (1992), social settings affect not only group members' authority positions within the group, but also the '*knowledge claims*' group members make to support their hierarchical positions. One of the major contributions made by Lazega (1992) is his examination of the way in which members of work groups are constantly claiming legitimacy for their knowledge by forming stable social relations with other group members.

2.4.3 Using the Social Construction Perspective to Study Organisational Knowledge and Knowledge Integration Processes

The above discussion has examined various theories and ideas derived from the social construction perspective. These contributions are not mutually exclusive but reinforce

each other. Together, they constitute a gradual expansion and consolidation of the social construction perspective. Furthermore, they all share the view that the essence of studying any social process lies in the understanding of the dynamics of social interaction. The following discussion explores how the social construction perspective can help form an alternative approach to the study of organisational knowledge and knowledge-related activities.

2.4.3.1 The Social Construction Perspective on Organisational Knowledge

The social construction perspective adopted in this thesis provides a useful philosophical lens not only to understand the nature of organisational knowledge, but also to investigate processes of knowledge integration. It is clear from the strategy research literature that organisational knowledge is often perceived as a set of commodities or assets that have significant strategic value and can be transferred and utilised independently of their social context. However, from a social construction perspective, organisational knowledge is a set of shared, consensual beliefs that are constructed through social interactions and embedded within the social contexts in which such knowledge is created. Hence, only by understanding the dynamics of social interaction, and the evolutionary process of knowledge and its social context can the underlying meaning of knowledge be externalised and understood. On the other hand, the strategic perspective's assumption that the accessibility and value of organisational knowledge are unconditional and unproblematic appears to be partial and unrealistic.

This further emphasises the importance of using the social construction perspective as a means of understanding the nature of organisational knowledge. First, the socially

embedded nature of organisational knowledge indicates that organisational knowledge is not always shared and cannot always be accessed by its members (Moorman and Miner 1997). The boundaries surrounding organisational subunits further limit the access of members to other subunits' knowledge. Secondly, because of the way in which knowledge is created, the strategic value of organisational knowledge cannot always be considered as purely positive or advantageous to the organisation. As Latour (1987) and the SCOT theorists argue, the development of technology and innovation is not always a matter of finding the 'best solution'. In other words, the development of technology and even the content of organisational knowledge are composed of processes through which various competing thoughts are disclosed and a consensus amongst involved members is attained.

Furthermore, these processes are influenced by the '*network ties*', or social capital to use Nahapiet and Ghoshal's (1998) terms, among the '*relevant social groups*' (Pinch and Bijker 1987), and the exertion of power by the involved members, referred to by Lazega (1992) as *'knowledge claims'*. The construction of social knowledge is like making a '*technical decision*' (Pinch and Bijker 1987) that is based on negotiation and interpretation and contains '*interpretative flexibility*' (Collins and Pinch 1982). Therefore, the construction process cannot always be 'bias-free', and organisational knowledge can easily become obsolete and irrelevant through the change of its social context. This is why the concept of the 'unlearning' of such obsolete and invalid knowledge (Hedberg 1982; Nystrom and Starbuck 1984) is important. From these arguments, it is clear that, according to the social construction perspective, organisational knowledge must be seen as socially constructed and embedded,

containing positive and negative elements and selectively dispersed within the organisation with various degrees of accessibility.

2.4.3.2 The Social Construction Perspective on Knowledge Integration Processes

With a primary focus on the utilisation of organisational knowledge, the strategic school of thought gives little attention to the process by which knowledge is integrated. By comparison, the social construction perspective, with its main objective of investigating the process of the creation and development of social reality, provides a more suitable and adequate theoretical stance to investigate processes of knowledge integration. Following the social construction perspective, the investigation of these processes requires the examination of the social interactions among organisational members. As Latour (1987) suggests, this is like opening up the 'black box'. Hence, the main aim must be to find out how stabilised social relations are formed and reformed.

In the case of knowledge integration, this means discovering how different sources of knowledge are synthesised through the ongoing interactions between relevant social groups that continuously stabilise and destabilise their social relations. This point is mirrored in the concept of situated learning (Lave and Wenger 1991) that explains how newcomers learn and acquire their 'community memberships' through the participation and observation of the experienced members, and how the experienced members modify what they have learnt through their mutual interaction. Secondly, it is manifest from the discussion of the SCOT approach and actor-network theory, that a clear distinction between the social and technical elements cannot be drawn, because the interconnection between the two forms a '*seamless web*' through the construction process (Bijker et al.

1987; Latour 1987). Hence, it is clear that organisational knowledge and the social interaction that constructs this knowledge cannot be studied in isolation.

Finally, the social construction perspective provides a more appropriate approach to studying knowledge integration processes than does the information-processing school of thought. The latter emphasises the efficiency of information dissemination as a means of innovation success, but accordingly neglects the fact that the interpretation of information and even knowledge is not universal and unproblematic. By contrast, the social construction perspective, with its emphasis on the disclosure of different interpretations, takes into account the process by which a commonly acceptable interpretation can be achieved through negotiation and interaction (Pinch and Bijker 1987). It further suggests that the study of knowledge integration-processes must focus on understanding how paradigmatic differences are resolved through social interaction. This point is reflected in the concepts of perspective taking and perspective making, as proposed by Boland and Tenkasi (1995). In conclusion, according to the social construction perspective, knowledge integration can be perceived as an ongoing process of social interaction between participating members as a means of disclosing paradigmatic difference to achieve a commonly acceptable interpretation and shared understanding of social reality.

2.5 Theoretical Gaps and Researchable Questions

2.5.1 Introduction

The above analysis has scrutinised the literature on organisational knowledge and knowledge-related activities, and has examined other contributing insights. In this section, the key issues raised in each part of the discussion are summarised and synthesised in order to identify theoretical gaps. This leads to an identification of the major research questions to be explored in this thesis. However, it must be stressed that not all theoretical gaps can be handled in a single study. Indeed, not all theoretical gaps are researchable. Therefore, the emphasis here is on selecting researchable questions and sub-questions of broad conceptual significance.

Despite the fact that debates on knowledge have been ongoing for several centuries, it is only recently that knowledge as a collective phenomenon in the organisational context has been studied in its own right. Knowledge can be understood not only in terms of what people *know*, but also as what people *do*, as Blackler's (1995) concept of knowing suggests. In seeking to clarify the relationship between knowledge and other related terms such as skill, expertise, paradigm and organisational memory, two contradictory theoretical assumptions emerge. Studies based on a resource-based view commonly perceive knowledge as a set of institutionalised, strategically valuable commodities that exist independently of their creators, that can be understood without taking into account the contexts within which the knowledge is constructed (Davenport and Prusak 1998; Prahaled and Hamel 1990). By contrast, the other school sees knowledge as a set of interlinked social realities that are constructed collectively by people and that can be observed from what people do, and how and why they do it (Berger and Luckmann 1967; Kuhn 1970). This view on knowledge elaborates the underlying assumption held

by this study in trying to understand knowledge integration processes and investigate the phenomenon of cross-functional knowledge integration.

2.5.2 The Unit and Context of Analysis

The multi-levels of existence approach described earlier, shows that the organisational knowledge created by individuals can be observed not only at the individual but also at the group and organisational level. Critically, knowledge-related activities referring to the group and organisational levels cannot simply be perceived as merely an aggregation of individuals. In contrast with the literature on knowledge-related activities at the individual and organisational levels, the literature on group-level analysis is rather limited, particularly in relation to communities and cross-functional teams. This recognition has led this thesis to emphasis the group context in order to fill a major theoretical gap, although the organisational level is not excluded.

2.5.3 The Identification of Researchable Questions

2.5.3.1 The Accessibility of Organisational Knowledge

The dispersion of organisational knowledge and memory is highlighted by Tsoukas (1994) and Walsh and Ungson (1991). However, the variation in accessibility indicates that organisational knowledge and memory are not only dispersed, but also selectively distributed (Moorman and Miner 1996). Therefore, two of the most fundamental research questions are:

How does a group member access the knowledge he/she requires?

What are the issues influencing such accessibility?

2.5.3.2 Situated Learning and Communities of Practice

As Lave and Wenger (1991) argue, learning is not just a matter of acquiring skills and knowledge, but also socialising with other community members through participation. They term this phenomenon '*legitimate peripheral participation*'. Their concept has been further extended by studies of '*community of practice*' (Brown 1991; Brown and Duguid 1991; Orr 1990), which seek to show how members learn through narrative sharing and socialisation within a community. Two questions which address two different levels of analysis surfacing from these concepts are:

How does a community learn from other communities, and how does collective learning take place among communities?

When community members are dispersed geographically, how does legitimate peripheral participation take place?

2.5.3.3 The Prioritisation of Knowledge Integration

Demsetz (1991) draws attention to the cost of knowledge, an issue that is commonly ignored by economic theories, as well as other organisational knowledge studies. The cost of knowledge raises several issues about how knowledge-related activities are prioritised and how resources are allocated. Two research questions emerge from this aspect:

What are the main issues that influence the decision processes associated with the prioritisation of knowledge-related activities?

How can the necessary resources required for the continuity of knowledge integration be secured and sustained?

2.5.3.4 Perspective Taking and Knowledge Integration

From the cognitive perspective, knowledge integration can also be regarded as a collective mental development process. Concepts such as 'collective mind' (Weick and Roberts 1993) and '*perspective taking*' (Boland and Tenkasi 1995) are particularly useful in explaining how a commonly shared perspective is constructed. At the same time, knowledge sharing demands the exchange of paradigms and perspectives, and this in turn requires mutual learning and knowledge integration (Boland and Tenkasi 1995). Three questions derived from these arguments are:

How is the decision made about which perspective to take or whether a new perspective should be formed?

What are the main issues that influence the process of perspective taking?

What role does the new perspective play in the knowledge integration process?

2.5.3.5 Organisational Memory and Knowledge Integration

It has been argued that the four primary roles of organisational memory are: interpretation, action guidance, co-ordinating activities, and integrating knowledge (Moorman and Miner 1997; Walsh and Ungson 1991). Organisational memory as an 'organisational frame of reference' (Shrivastava and Schneider 1984) enables members to interpret their past experience and take future action. More critically, it provides guidance on how knowledge should be integrated. Three questions associated with this argument are:

What are the relationships between the refinement of organisational memory and the process of knowledge integration?

How does organisational memory influence the way in which knowledge is integrated, and in what degree?

2.5.3.6 Knowledge Integration Processes

Despite the widespread recognition of the importance of the concept of knowledge integration, the underdevelopment of this concept is evident in the review of the current literature. There is a conspicuous lack of a comprehensive theory with empirical evidence in the knowledge integration research area. Accordingly, this thesis seeks to explore the processes of knowledge integration and to generate a theoretical account of those processes. The above discussions point to various perspectives on the process of knowledge integration and the key issues that affect the process. However, one critical issue has been neglected in the literature: the interrelationships between various processes. Therefore, the last question to be dealt with in this research is:

What are the dynamic interrelationships between various cross-functional knowledge integration processes?

After illustrating all research questions which are vital to the examination of cross-functional knowledge integration processes, the following chapter outlines various issues related to how the proposed research questions can be answered from the empirical evidence.

Chapter Three- Research Methodology

3.1 Introduction

The literature review (Chapter Two) revealed a number of areas of concern that deserve further investigation. The main purpose of this chapter is to discuss the methodological issues which arise in relation to those areas. The formulation of an adequate research design depends on a consideration of divergent approaches and strategies. The ontological and epistemological foundations of the research are presented in this chapter. Ontology is the science or study of being, and epistemology is the theory or science of the method or grounds of knowledge (Blaikie 1993). The discussion of these two dimensions is intended to demonstrate the philosophical stance of the researcher, and to display the connections between the research objectives and the chosen research methods.

Based on the previous chapter's review of the current literature, three key research questions have been selected for special attention:

- **What are the processes of knowledge integration within cross-functional project teams?**
- **What are the interrelationships between various knowledge integration processes?**
- **What influence these dynamic processes?**

This chapter starts with a discussion of major philosophical debates and discusses their relevance to the research design for this study. The strengths and weaknesses of various research methods are examined. The rationale behind the choice of research methods in relation to the collection of evidence is explained. Finally, there is a discussion of how the collected research data are analysed and how this leads to the fulfilment of the research objectives.

3.2 Research Design

The functions of research design are fourfold: to provide the researcher with a blueprint for the enquiry, to establish the boundaries of the research, to focus the research efforts in a specific direction, and to anticipate potential problems in the implementation of the enquiry (Bogdan and Taylor 1975; Glesne and Peshkin 1992). The specific objectives of the research, the nature of the research topic, and the characteristics of the research areas must also be taken into account when forming the research design (Golden-Biddle and Locke 1997). In addition, the scope of the research, the availability of resources, the strengths and weaknesses of the researcher in terms of research skills, and time constraints also influence the choice and formulation of the research strategy (Yin 1984). The following sections highlight three of the fundamental issues influencing the research design: philosophical stance, the contrast between quantitative and qualitative research, and the research orientation (in terms of it being a theory building and/or a theory testing exercise).

3.2.1 Philosophical Stance

Debates on the nature of social science and the appropriateness of different methods of social enquiry have their roots in contrasting views of the nature of reality, and of how knowledge of that reality can be obtained (Alvesson and Sköldberg 2000; Blaikie 1993). The conventional distinction between the approaches of positivism and phenomenology in relation to their view of the nature of social reality is especially important in this respect (Easterby-Smith, Thorpe and Lowe 1991; Glesne and Peshkin 1992). Blaikie (1993) labels these two traditions 'realist' and 'constructivist'. According to Blaikie, positivism, critical rationalism and realism share the same ontological assumption that social reality is ordered and independent of actors and their social activities. Therefore, universality can be observed, measured and explained. The main goal of the positivist is to seek the causes of social phenomena with little regard for the subjectivity of individuals (Easterby-Smith, et al 1991). Criticisms of positivism commonly focus on the inappropriateness of natural-scientific methods for inquiry into the human or social sciences (Klein and Myers 1999; Orlikowski and Baroudi 1991). Consciousness, cultural norms, symbolic meanings, and intentionality, which are seen as distinctly human attributes, indicate a methodological gap between natural science and the study of human life in society (Gable 1994; Klein and Myers 1999).

By contrast, interpretivism, critical theory, structuration theory and feminism are based on phenomenological (constructivist) ontological assumptions (Husserl and Husserl 1970), and see social reality as constructed and reconstructed by social actors who pre-interpret and interpret social meanings (Berger and Luckmann 1967; Cullen 1998; Fulk 1993). These theories argue that a knowledge of social reality can only be achieved by

the researcher immersing himself/herself in appropriate social settings in order to understand its meanings, rules and languages (Gergen and Thatchenkery 1996; Hatch 1997). The main goal of the phenomenologist is to investigate '*the ways in which people create or discover meaning for themselves, try to make sense of the actions of others, and together negotiate sensible social relations*' (Harmon 1990, p. 11).

Derived from a phenomenological stance, this thesis has been greatly influenced by several seminal works in the tradition of social constructionists, including those of Mead (1934), Berger and Luckmann (1967), Blumer (1967), and Glaser and Strauss (1967). This research adopts the social construction perspective that meanings emerge through the verbal and social interaction of actors (Berger and Luckmann 1967). The main epistemological concern of social construction perspective is to analyse and understand such meanings (Reichers 1987). Such a perspective underpins the formation of this research design as well as the choice of data collection methods. As explained in the literature review, the main objective of this research is to fill major theoretical gaps by investigating the processes of knowledge integration in a cross-functional project team context, and identifying the issues that influence knowledge integration processes. Following the principles of social construction perspective, it is argued that reality is not only socially constructed, but is also internal to social actors (Strauss and Corbin 1990). Hence, this reality can best be understood by interpreting actors' perceptions of social phenomena (Klein and Myers 1999). This suggests the need to adopt a philosophical approach, specifically social construction perspective, to conceptualise the dynamics of cross-functional knowledge integration. The phenomenological paradigm not only shapes the underlying logic of the research design, but also influences the

methodological considerations of the study. The next section compares different methodological approaches, and explains the rationale behind the formulation of the present research design as a means of fulfilling the research objectives.

3.2.2 Quantitative versus Qualitative Research

As explained above, positivism and phenomenology articulate different paradigms in relation to their underlying epistemological and ontological assumptions. These differences not only influence the way in which the two approaches view reality, but also have implications for the choice of research aims and methods (Bogdan and Taylor 1975; Firestone 1987; Glesne and Peshkin 1992). Silverman (1997), drawing on the work of Halfpenny (1982), lists seven key distinctions between quantitative and qualitative research methods (see Table 3.1).

Table 3.1 The main distinctions between quantitative and qualitative research methods

Quantitative research	Qualitative research
Hard	Soft
Fixed	Flexible
Objective	Subjective
Value-free	Political
Survey	Case study
Hypothesis-testing	Speculative
Abstract	Grounded

(Source: Silverman 1997, pp.13)

Maxim (1999) suggests that quantitative research, based on a primary concern with objectivity, seeks to achieve explanations and predications that are generalisable to other

circumstances and settings. Such a viewpoint is also echoed by other scholars, such as Kish (1987), Thompson (1992) and Zeller (1980), who indicate that rigid sampling strategies, combined with identifiable variables and measurable relationships, form the data collection process and make it possible to obtain generalisable results. According to Phillips (1987), based on the ontological assumption that social reality is independent of human minds, the role of the quantitative researcher is to obtain scientific knowledge through observing and measuring objective reality. Griffin and Kacmar (1991) and Todd (1979) further argue that methods such as surveys, experiments, inventories and demographic analysis are employed to produce quantitative data on the basis of which correlation between defined variables can be established.

According to Everd and Louis (1981) and Van Maanen (1979), qualitative research aims to explore, investigate and understand phenomena which are socially constructed, complex and indivisible into discrete variables. Bryman and Burgess (1999) define qualitative research as:

> '*A strategy of social research which deploys several methods (often in conjunction in specific studies) and displays a preference for: the interpretation of social phenomena from the point of view of the meanings employed by the people being studied; the deployment of natural rather than artificial settings for the collection of data; and generating rather than testing theory.*' (p. x)

According to this definition, the aim of qualitative research is not to measure and predict the studied phenomena, but to interpret the social actor's perception of the meanings embedded within social settings (Cochran and Dolan 1984; Sackmann 1992). Das (1983) indicates that qualitative research, by focusing on the unfolding of the process rather than the structure, is broader and more holistic than quantitative research. Furthermore, some researchers (see for example, Bryman and Burgess 1999; Das 1983; Silverman 1997; Yin 1984) indicate that qualitative research often uses case studies as its preferred method of study in contrast to the surveys and experiments of quantitative research.

As already explained, this thesis does not seek to test or measure the relationship between the chosen phenomena, nor to offer any predictions. Rather, it aims to understand how various sources of knowledge are integrated through the social interaction of cross-functional project team members. In other words, it follows the principles of social construction perspective (Berger and Luckmann 1967; Glaser and Strauss 1967). Qualitative, rather than quantitative, methods are clearly appropriate, given this study's research objectives.

3.2.3 Theory building versus theory testing

Another critical issue in any research design concerns the underling orientation towards theory. For some authors (e.g. Easterby-Smith, *et al.* 1991; Phillips and Pugh 1987), the question is whether data or theory should come first. Thus, if the purpose of research is to test, expand or modify an existing theory, then theory must come before the data collection. On the other hand, if a researcher seeks to generate a theory from the

collected data, then the data must precede theory. Some authors (e.g. Bryman 1989; Bryman and Burgess 1999) relate the difference between theory testing and theory building to that between quantitative and qualitative research methods. Snow and Thomas (1994) examine the relationship between the stage of theory development (building or testing) and the purpose of theory (description, explanation or prediction), and delineate various possible research methods accordingly. The following table (Table 3.2) presents six scenarios linking the two basic orientations (theory- building and theory-testing) to three distinct purposes of theory: description, explanation or prediction. The six resulting combinations highlight the major differences between qualitative and quantitative research.

Table 3.2 Theory building and theory testing

	Description	**Explanation**	**Prediction**
Theory Building	Key question is 'what'. Identify key constructs and variables. Studies are usually based on observation and/or interviewing.	Key questions are 'how' and 'why'. Establish relationships among constructs and provide theoretical rationale for observed relationships. Studies usually use observation and/or interviews.	Key questions are 'who', 'where' and 'when'. Examine boundary conditions of a theory. Result may be a middle-range theory. Studies use observation, questionnaire surveys, and interviewing.
Theory Testing	Focus is on developing and validating measures of key constructs. Studies usually use questionnaire, surveys and/or interviews.	Focus is on documenting relationships among variables through hypothesis testing. Large samples are frequently used with questionnaire surveys or field simulations. Because causal links are examined or implied, researchers must be wary of common-method bias.	Focus is on testing competing theories of the same phenomenon through crucial experiments. Because of the dearth of this type of study, no pattern in field method usage can be discerned.

Source: Snow and Thomas (1994, pp.466)

Researchers engaged in theory building argue that '*the development of theoretically informed interpretations is the most powerful way to bring reality to light*' (Strauss and Corbin 1990, p. 22). In particular, this is reflected in the concept of grounded theory that uses an inductive approach for theory building (Glaser and Strauss 1967; Martin and Turner 1986; Strauss and Corbin 1990; Turner 1983). The grounded theory approach is defined by Strauss and Corbin (1990) as '*a qualitative research method that uses a systematic set of procedures to develop an inductively derived grounded theory about a phenomenon*' (p. 24). Furthermore, Strauss and Corbin (1990) suggest that the grounded theory should be constructed according to theoretical sensitivity and through a process of constant comparison of data and theory, starting with data collection. Whereas theory-testing relies mainly on surveys, simulations and experiments for data collection (Snow and Thomas 1994), the case study is the main research tool for building theories (Eisenhardt 1989). In the context of the present analysis, attention has already been drawn to the conspicuous lack of theories and empirical evidence capable of depicting the dynamics of knowledge integration within the context of cross-functional project teams. Accordingly, for the purpose of this research, case studies have been utilised in an effort to generate a theory capable of filling the gap in the literature.

3.2.4 Research Design: Case Study

3.2.4.1 Introduction

The case study method is used in a variety of philosophically and methodologically diverse ways in the social sciences (Platt 1988). This reflects researchers' different views of the nature of case studies (Klein and Myers 1999; Plott 1988). Within the

methodological literature, phenomenology (interpretivism) is often associated with case studies, and positivism with surveys (e.g. Lee 1989), However, such linkages can be problematic and misleading. For instance, Klein and Myers (1999) cite examples of case studies that are consistent with the conventions of positivism (e.g. Benbasat, Goldstein and Mead 1987; Lee 1989; Yin 1984). Similarly, Bryman and Burgess (1999) note that '*the case study represents one of the most common frameworks or research designs for the conduct of qualitative research. This is not to suggest, however, that the two should be regarded as more or less synonymous*' (p. xiv). For instance, Platt (1988) identifies numerous examples that deploy case study design for the purpose of quantitative research. From these arguments, it is clear that a case study as a research design can be conducted as part of both qualitative and quantitative research, and can be based on either of two distinctive philosophical stances -- interpretivism and positivism. Furthermore, based on Bryman and Burgess's (1999) argument, this study is aware that associations of positivism with quantitative research methods and interpretivism with qualitative methods, in particular case studies, cannot be perceived as an absolute dichotomy. In this analysis, the use of case studies stems from an interpretative, and more specifically a social constructionist, perspective linked to the goal of theory building.

3.2.4.2 The Advantages and Disadvantages of Case Study

The immediate advantages of a case study are fourfold. First, it affords flexibility with respect to the adoption of multiple data collection methods (e.g. Black and Champion 1976; Robson 1993; Yin 1984). Secondly, case studies generate insightful stories rather than statistical information (Mitchell 1983), and this permits a better understanding of

organisational complexity (Van Maanen 1979) from an insider's perspective (Evered and Louis 1981). Thirdly, a case study enables the researcher to obtain a more holistic perspective on the studied phenomenon (Gummesson 1991; Lee 1989), and in particular to explore a '*previously little-studied area*' (Benbasat et al. 1987). Fourthly, a case study can be applied to various social settings of research (Stake 1995; Mitchell 1983). However, case studies also have certain disadvantages. In particular, there are limitations in terms of the generalisability and representativeness of social phenomena, and also concerns about the validity of the findings (Gummesson 1991; Scott 1997; Yin 1984). These issues are dealt with more fully below.

3.2.4.3 The Issue of Generalisability

On the question of generalisability, several points need to be made. First, a case study aims to develop rich contextual data, not to generalise the chosen phenomena into a concrete set of laws for measurement and prediction (Bryman and Burgess 1999; Platt 1988; Stake 1995). This is reflected in the idiographic approach, which emphasises the understanding of social phenomena from an individual-centred viewpoint within a natural environment context (Luthans and Davis 1982). In relation to the aim of this thesis, which is to investigate individual differences in knowledge and the processes of knowledge integration, the nomothetic approach, which is group-centred, standardised and takes place within a controlled environment, is clearly inappropriate (Luthans and Davis 1982). Secondly, with the proposed research objectives and the nature of research questions, it is commonly agreed that case studies help to generate theories which can then form the theoretical basis for quantitative testing that further enables generalisation (Eisenhardt 1989; Mitchell 1983).

3.2.4.4 Issues of Validity and Reliability

Altheide and Johnson (1997) define validity as '*the accuracy and truthfulness of the findings*' (p. 487). Kidder and Judd (1986) distinguish between four types of validity that are crucial to all social science research: construct validity, internal validity, external validity, and reliability. These four types of validity are relevant during different stages of research. For example, construct validity and reliability become the major concern during the data collection processes; internal validity is the key during the data analysis stage; and external validity is crucial to the research design.

Table 3.3 Case study tactics for four design tests

Tests	Case study tactic	Phase of research in which tactic occurs
Construct validity	- use multiple sources of evidence - establish chain of evidence - have case study report	Data collection Data collection Composition
Internal validity	- do pattern-matching - do explanation-building - do time-series analysis	Data analysis Data analysis Data analysis
External validity	- use replication logic in multiple case studies	Research design
Reliability	- use case study protocol - develop case study data base	Data collection Data collection

(Source: Yin 1984, pp.33)

As Altheide and Johnson (1997) observe, the essence of interpretive validity -- internal validity in Kidder and Judd's (1986) term -- is to '*elucidate the experience that is implicated by the subjects in the context of their activities as they perform them*' (p. 491). Yin (1984) summarises Kidder and Judd's (1986) concept (see Table 3.3.) to indicate the need for different kinds of validity at various stages of research. Table 3.3

provides a guideline for ensuring validity and reliability, and enables the researcher to check these tests according to the requirements of each research stage.

3.2.4.5 The Issue of Triangulation

Triangulation is a process designed to enhance the validity and reliability of a case study (Denzin 1970, 1988). It involves the use of multiple data collection methods to obtain various sources of evidence as a means of increasing the trustworthiness of the data and the validity of the explanation of social phenomena (Patton 1990; Todd 1979; Yin 1984). Furthermore, some authors (e.g. Bryman 1989; Corner 1991; Cowman 1993; Powell 1997) argue that triangulation enables the researcher to reconcile the opposing positions held by qualitative and quantitative methodologies. There are four types of triangulation (Denzin 1989; Easterby-Smith, *et al.* 1991; Patton 1990; Smith 1975; Yin 1984): data triangulation, investigator triangulation, theory triangulation, and methodological triangulation. Denzin (1989) argues that the incorporation of multiple data sources, investigators and theoretical perspectives strengthens confidence in research findings. For Todd (1979), triangulation is a creative approach which enables the researcher to maximise the depth and breadth of data collection. However, Corner and Wilson-Barnett (1992) and Payne (1997) point out that triangulation enables a more comprehensive understanding of the studied phenomenon, but that this technique does not resolve the contradictions created by different sources of data. In response to this concern, Strauss and Corbin (1990) and Miles and Huberman (1994) stress that in fact, contradictory data often provide a rich source of creativity and serve as a vital mechanism for expanding the researcher's thinking.

3.3 Case Study: The Fieldwork Research Design

Following on from how the philosophical stance, the nature of the research, and the research orientation influence the research design and the choice of a case study approach, this section highlights various processes through which the proposed objectives can be achieved. Drawing on current methodological literature, especially the work of Eisenhardt (1989), Miles and Huberman (1994); Stake (1995), Strauss and Corbin (1990), and Yin (1984), a number of issues require attention: shaping the case study protocol; conducting a pilot study, selecting cases, collecting data from the field; and data analysis. These can be categorised into two broad phases: the preparation phase includes the case study protocol, the pilot study and the selection of cases; the data collection phase covers gaining access to the case sites and the deployment of multiple methods for data collection. Other vital processes -- data analysis, literature comparison and writing up are outlined in Sections 3.4 and 3.5.

3.3.1 The Preparation Phase

3.3.1.1 Shaping the Case Study Protocol

A case study protocol is not merely a written plan, but also a reminder for the researcher about the rules and procedures, and a tool to enhance the reliability of a case study (Stake 1995; Yin 1984). Gummesson (1991) and Taylor and Bogdan (1984) explain that a case study protocol should explicitly express how and why different sources of data are collected. In accordance with Yin (1984) a case study protocol containing an overview, procedures, research questions and a guide for the case study report was prepared for the case studies to be undertaken here. While it was recognised from the

start that multiple data collection methods were required (Eisenhardt 1989), the sheer variety of available methods inevitably made selection difficult. Commonly discussed methods included observation (Calder and Sheridan 1984), interviewing (Holstein and Gubrium 1997), focus groups (Kitzinger 1994), biography (Stanley 1994), documentation (Miller et al. 1997), diaries (Burgess 1981), conversation analysis (Silverman 1998), and physical artefacts (Yin 1984). In the final research protocol for this study, observation, interviewing and documentation (Burgess 1982; Dingwall 1997; Eisenhardt 1989; Scott 1997) were all included to enhance the richness of the data and increase the validity through triangulation.

3.3.1.2 The Pilot Case Study

The advantages of conducting a pilot study are threefold. First, it serves as an effective approach to assess the appropriateness of the case study protocol (Yin 1984). Secondly, it helps to determine whether the interview questions suit the research objectives (Stake 1995). Thirdly, as Janesick (1994) notes, it '*allows the researcher to focus on particular areas that may have been unclear previously*' (p. 213). Following the construction of the case study protocol, a pilot case study protocol was formulated. In so doing, the issues of convenience, access and geographic proximity (Yin 1984) had to be considered. In addition, to help develop the researcher's hands-on research skills and experience, a 'full scale' pilot case study was undertaken. The following discussion highlights the problems associated with gaining access and considers the lessons learnt from the pilot case study.

3.3.1.2.1 Selecting and Gaining Access to the Pilot Case Site

With the research objectives in mind, the selection of the pilot case site was based on the concept of theoretical sampling (Glaser and Strauss 1967). This suggests that the selection of the site must primarily emphasise theoretical relevance in relation to the chosen research purposes (Eisenhardt 1989; Orlikowski 1993). Accordingly, the choice of project and cross-functional team were identified as key issues. It was felt necessary to choose a project that was being implemented cross-functionally. The rationale for this was that the intention was to explore the processes of cross-functional knowledge integration. In terms of the project team, the geographical dispersion of team members and programme participants was one of the main concerns. This consideration was based on the definition of the virtual team provided by Morgan (1997), as discussed in Chapter Two.

The process of gaining access to a pilot site began in June 1997. The original plan was to access multinational companies in the information technology industry because of the researcher's previous experience in that sector. Introductory contact letters were sent to several companies, such as IBM, Sun Microsystems, Apple, ICL, Compaq, Dell, Texas Instruments and Acer. All but the first two companies immediately rejected the proposal. Sun Microsystems eventually turned down the proposal in September 1997, and there was no response from IBM. After these discouraging results, the researcher realised that it was likely to be very difficult to gain access to an appropriate research site. A second wave of accessing was initiated, focusing primarily on research and development oriented companies. Letters were sent to over 40 additional companies including Kodak, Unilever, SmithKline Beecham (SB), British Telecommunication (BT), Rover, Boots

The Chemists (BTC) and Sony. Telephone calls were made a week after the letters were posted. While, as expected, the majority of companies turned down the proposal, there were a few that were more encouraging. During a meeting with the Motor Industry Research Association (MIRA) in October 1997, one of the managers suggested postponing the research project for six months. The researcher agreed to do this and contacted MIRA again six months later, but this time the manager said that the research project was no longer important to the company. Marathon negotiations with SB (8 months) and IBM (1 year 3 months) through numerous meetings and e-mails reached no conclusion (although by this stage, a pilot study had been completed in BP Amoco). During this period of time, BTC was the only company whose response was uncertain.

A meeting with the plant manager at Birdseye Walls (a subsidiary of Unilever) led to the company insisting that the researcher should study the ice cream production teams in exchange for access to the company's innovation centre. Eventually, the researcher turned down this proposal because the personnel director suggested studying only the shop floor teams and not the innovation centre. A more positive response was received from Kodak, who agreed to the researcher studying a cross-functional R&D project team. A research contract was signed, documentation related to the company's background and the specific project was collected, and interview questions were developed. However, redundancies were initiated by Kodak US and 10,000 jobs were cut in late 1997. Further redundancies followed in Kodak UK in early 1998. The research project eventually had to be abandoned as several team members were made redundant. Yet again, the researcher had to look for alternatives for the pilot study.

The third wave of accessing commenced soon after rejections were received in the second wave. With a slight shift in focus, cross-functional management teams rather than R&D teams were targeted. Letters were sent to Arthur Anderson, British Petroleum Amoco (BP) and National Grid Company (NGC). In the last two cases, access was granted. The contact process with BP was the most efficient. A week after a phone call to the Chair of BP, Sir John Browne, a contact name and telephone number were provided by Sir John's personal assistant. A meeting with the BP Knowledge Management Team was conducted in October 1997, and an agreement was reached soon afterwards, although the pilot study did not start until January 1998. The BP Knowledge Management Team thus became the designated case for the pilot study.

3.3.1.2.2 The Lessons Learnt from the Pilot Study

As Robson (1993) suggests, a pilot study offers the researcher valuable opportunities to 'learn on the job'. The following discussion highlights some of the vital lessons learnt from the pilot study. First, in terms of developing research skills, the pilot study provided an excellent opportunity for the researcher to improve his formulation of interview questions, interview techniques, and observation and writing skills. Analysing and managing the data collected from the pilot study also provided a real-time experience that could not possibly have been gained by reading alone.

Secondly, the experience gained from the BP case revealed a major problem in understanding the interviewees effectively owing to their use of industry-specific knowledge. The researcher's own lack of knowledge in relation to such matters as oil exploration, oil refining and chemistry gave rise to serious difficulties. For example, it

tended to slow down the flow of interviews. On the basis of this experience, the researcher decided that a reasonable period of time must be allowed to obtain some basic industrial and technical background knowledge, and that this issue must be incorporated in the negotiations with any potential research site.

Thirdly, the pilot study helped to improve the research design, and taught the researcher to be more critical and sensitive about the data. It was found, for example, that the way in which a cross-functional project team was actually organised differed in some important respects from the accounts in some of the project management literature (e.g. Kloppenborg and Petrick 1999; Tippett and Peters 1995), e.g. in terms of the number of projects managed by the team. In the pilot case, the Knowledge Management Programme consisted of many projects that were implemented by the team members individually. In the cross-functional project literature, however, teams are usually discussed as being responsible for one project which is collectively implemented by the team as a whole. Furthermore, the pilot study revealed some limitations in using the team as the unit of analysis. By interviewing only team members, there was a danger of not being able to obtain some rich insightful stories emanating from the relationship between the team and other stakeholders of the project. This realisation helped the researcher to reshape the research design and adopt the project, rather than the team, as the unit of analysis.

Another vital lesson gained was the importance of trust building in relation to the process of data collection. Although the importance of trust is addressed in the methodology literature (e.g. Currer 1992), there are few positive suggestions about how

to strengthen trust between the researcher and the researched. Experience gained from the pilot study suggested that trust could best be established through increased interaction between the researcher and the researched, in particular during informal occasions such as coffee breaks or lunch. An agreement between the researcher and the researched also helped to reassure all information-providers that what they said would be treated in the strictest confidence.

In terms of theoretical and methodological development, some vital lessons were also gained from the pilot study. From the theoretical aspect, it was clear that the social networks that existed between organisational members, in particular those who worked for different business units, played a critical role in the processes of knowledge integration. Also, evidence from the BP Amoco case highlighted the need to take into account the geographic dispersion of programme participants in investigating cross-functional knowledge integration processes. From a methodological aspect, findings from the pilot study suggested that the study of cross-functional project teams could not be limited to the formal project team boundary. Instead, it was vital to investigate the interplay between the project team, project stakeholders and the rest of the organisation. In other words, a broader scope in terms of selecting interviewees, reviewing documentation and observing social interaction needed to be incorporated into the study of cross-functional knowledge integration processes.

3.3.2 The Data Collection Phase

3.3.2.1 Introduction

The main purpose of this section is to illustrate how the research sites were accessed and how various data collection methods, namely interviewing, on-site observation and documentation, were employed to operationalise the research design and obtain the answers needed to fulfil the research objectives. The integration of the data collection methods and the problem of ensuring the validity of multiple sources of data are also discussed.

3.3.2.2 Gaining Access

Based on the same criteria of theoretical sampling used to select the pilot case (Glaser and Strauss 1967), the selection of case sites again focused on cross-functional project teams with dispersed team members. After two waves of failure in accessing case companies, the only two remaining companies from the second and third waves were NGC and BTC. An agreement with the manager of NGC's Network Replacement Department, was reached in March 1998, when the pilot study in BP was still in progress. On the basis of the experience gained during the pilot study, it was decided to spend six months, starting at the beginning of April 1998, acquiring some basic knowledge relating to power transmission and power networks which was the main business of the Network Replacement Department. Several meetings were held, supplemented by numerous e-mails and phone calls. At the same time, six semi-structured interviews and other discussions were conducted with members of staff outside the department. However, a change of department manager in October 1998 put the project into a state of uncertainty, although the data collection processes continued. A meeting with the new manager a few days before Christmas 1998 confirmed that the department was still willing to continue with the research. However, a telephone call to

the secretary at the beginning of February 1999 revealed that the manager had changed his mind. After more than eight months of effort it was necessary to bring the incomplete case study to a halt.

The contact with BTC, which started in October 1997, led to no further developments for almost a year; but in September 1998 there was a telephone call from Mr. Iain Hildyard, a member of the Business Process Redesign (BPR) Team. Mr. Hildyard expressed his interest in the research project, and indicated the possibility of conducting research within his team. Despite numerous telephone calls, e-mails and meetings, it was only in December 1998, at a further meeting with all team members, that a research agreement was concluded. As a result of the denial of access by NGC, a fourth wave of accessing sites began two days later. Because the list of suitable FTSE 100 companies was now almost exhausted, 23 letters were sent mainly to FTSE 500 companies, and one letter was sent to the Department of Trade and Industry (DTI). Finally after some meetings with ALSTOM, the DTI and NatWest GFM, agreements were reached. A one-year research contract was signed with the DTI which then also helped to gain access to three further companies: Robinson Brothers Ltd., Capricorn Communication and Dairy Ingredients UK.

Despite the fact that all six selected companies matched the outlined criteria, only BTC and NatWest GFM were incorporated into the final study. Following the concept of theoretical sampling (Glaser and Strauss 1967), these two sites were selected for their similarities as well as their differences (Orlikowski 1993). In terms of similarities, the rationale behind the selection was threefold. First, in terms of project scope, only BTC

and NatWest GFM had cross-functional projects with an organisation-wide coverage at this particular time. Secondly, unlike other cases, they had highly dispersed project team members and project participants. Thirdly, both projects had a similar duration of about three years. The combination of a fairly long project duration enabled the researcher to study the processes of knowledge integration across the various stages of the project. Because the main objective of the research was to generate theory applicable to various organisational contexts and differentiate issues influencing the integration processes, differences between the two projects in terms of project orientation and implementation activities also served as one of the main criteria. The following sections outline the details of the interviewing processes, on-site observation, and documentation.

3.3.2.3 On-site Observation

The purpose of on-site observation is to gain first-hand knowledge of how the researched act in their social settings (Altheide and Johnson 1997; Hunt and Benford 1997; Robson 1993; Silverman 1997; Yin 1984). This is a key aspect of the role taken by the researcher in investigating and interpreting the studied social phenomena. As already explained, the specific ontological and epistemological assumptions of the researchers determine how the nature of reality is perceived and how knowledge of it can be obtained. Positivists emphasise the externality of social reality and the ultimate goal of objectivity, and it is therefore vital for the researcher to be independent of the observed phenomena. In contrast, the phenomenological tradition is based on the idea of the social construction of reality, and claims that no researcher can be independent of the social phenomena being studied (Blaikie 1993; Easterby-Smith, *et al.* 1991; Robson

1993). This perspective means that on-site observation is an important means by which the researcher can interpret the social actor's world.

In this study, the main goal of on-site observation was to experience how knowledge was integrated through the social interaction between team members and between the project team and the rest of the organisation. A three-week period of observation was carried out at each of the two sites by attending meetings and undertaking discussions with organisational members during coffee- and lunch-breaks. Additionally, physical characteristics such as the office layout were also observed. Most importantly, efforts were made to observe the group dynamics directly by sitting in on team meetings. A total of 16 meetings were attended at the two sites, and this enabled the researcher not only to obtain vital information relating to the project, but also to observe the group dynamics within the two different settings. Notes were taken during each meeting, and further reflections were written up soon after the researcher had left the room. The informal discussions with team and other organisational members during coffee- and lunch-breaks proved to be especially valuable since the researched were often more willing to express their personal viewpoints at these times rather than during the formal interviews. This also enabled the researcher to note the differences between the stories told by the same interviewees on different occasions.

3.3.2.4 Interviewing

The following discussion concentrates on the theoretical as well as practical issues related to interviewing. These include the choice of interview structure, the formulation and piloting of interview questions, and the selection of interviewees.

3.3.2.4.1 Types of Interview

Various types of interview can be positioned on a continuum according to the degree of structure and the nature of interview questions (Jones 1985). On one side of the continuum, interviews based on predetermined questions and a standardised schedule are commonly termed structured interviews. The other side of the continuum represents unstructured interviews in which interviewers have a general area of interest and the interviewing process is determined by the flow of conversation (Robson 1993; Powney and Watts 1987). The middle ground of this continuum consists of semi-structured interviews that contain a clearly defined purpose with some degree of flexibility in the wording and ordering of questions (Robson 1993). According to Jones (1985), interviews can be further divided into two categories according to whether open-ended or closed questions are used. Another distinction is between in-depth interviews, which are used for obtaining the detailed insights of individual interviewees, and survey interviews, which are used to achieve broad coverage of the population (Jones 1985; Powney and Watts 1987).

In this study, the main aim is to understand cross-functional knowledge integration processes by unveiling how the social actors (team members) construct, categorise and interpret events in their world. Hence, in-depth interviews were conducted on a semi-structured basis with open-ended questions. This approach yielded the important advantage of flexibility (Yin 1984), and also corresponds to the rationale outlined by Jones (1985):

"to understand other persons' constructions of reality we would do well to ask them (rather than assume we can know merely by observing their overt behaviour) and to ask them in such a way that they can tell us in their terms (rather than those imposed rigidly and a priori by ourselves) and in depth which addresses the rich context that is the substance of their meaning (rather than through isolated fragments squeezed onto a few lines of paper)." (p. 46)

3.3.2.4.2 The Formulation and Piloting of Interview Questions

Based on the experience gained from the pilot study, it was clear that thorough pre-interview preparation was essential. Accordingly, an examination of the project background for each case study and the gathering of relevant knowledge for the business sectors concerned were undertaken. Information from archival records and documentation provided a broad coverage over a long time span. On-site observation enabled the researcher to obtain updated background information, particularly by attending meetings and consulting team members. This helped to articulate critical issues for inquiry and to enhance the formulation of appropriate interview questions.

Piloting interview questions enhances both their validity and appropriateness (Glesne and Peshkin 1992; Robson 1993). It also enables the researcher to modify the interview questions according to the feedback of interviewees and the researcher's own judgement. Two interviewees at each site -- outside the project teams -- were selected for the piloting process on the basis of two major criteria: their experience of working in a cross-functional project team, and their willingness to be interviewed and to discuss

the content of interview questions. The lessons learnt from the pilot interviews helped to reshape the interview questions in order to avoiding using terms such as knowledge management, social capital and organisational memory which most of the interviewees were unfamiliar with.

3.3.2.4.3 The Selection of Interviewees and Interviews

Based on the concept of theoretical sampling (Glaser and Strauss 1967), the selection of interviewees was based on the need to ensure that the responses could be seen to represent the reality constructed by the whole (Robson 1993; Smith 1975; Smith 1983). Thus, taking the project as the unit of analysis, one of the most immediate issues was to select interviewees who could collectively represent the project from various perspectives. Based on the experience gained from the pilot study, it was clear that to interview all team members was vital. However, it was equally critical to take into account those organisational members who were involved in the project on a part-time or short-term basis, as well as stakeholders who had influence over, or were the end users of, the project.

For the BTC case, 15 interviewees were selected from the BPR team and various business functions including Marketing, Space Management, Stores, IS and the Beauty, Healthcare and Leisure business units. In addition to the functional differences, interviewees were also selected from various sites that were dispersed in different parts of Nottingham. The fifteen interviews were conducted between March and June 1999, with three follow-up interviews during the third quarter of 1999. All interviews lasted between 60 and 90 minutes, with the exception of four interviews that lasted over two

hours. All interviews were tape- recorded by agreement with the interviewees, and then transcribed. Although it is recognised that the use of tape-recorders can have negative consequences (see, for example, Robson 1993; Yin 1984), the experience gained from the pilot study indicated that these effects could be reduced in several ways. First, all interviewees were consulted before using the tape-recorder. Secondly, reassurance was given that no information provided by the interviewees would be exposed without interviewees' explicit consent. Thirdly, the main reason for using a tape-recorder -- the need to compensate for the language and limited technical knowledge of the researcher -- was fully explained to all interviewees.

In the NatWest GFM case, 17 interviewees were selected from various management levels and business functions. The latter included Technology, Architecture, Risk and Finance Technology, Interest Rate Derivatives, Global Money Markets, Human Resource, Strategy, Programme Management and Operations. Additionally, interviewees were selected from offices in New York and Singapore, as well as two major sites in London. Nineteen semi-structured were conducted (two interviewees were interviewed twice), mainly during March and April 1999, with five follow-up interviews between September 1999 and January 2000 to obtain updated information related to the progress of the project. All interviews were tape-recorded by agreement with the interviewees, and then all but two were transcribed. All interviews were conducted on a face-to-face basis with the exception of two telephone interviews with subjects in Singapore and New York. The majority of interviewees were interviewed for between 60 and 90 minutes, but three were interviewed for more than two hours.

3.3.2.5 Documentation

In addition to on-site observation and interviewing, another source of data was documentation, including letters, written reports, administrative documents, newspapers and other relevant studies (Bailey 1982; Geertz 1973; Katz 1983; Yin 1984). For the purposes of triangulating data, Yin (1984) suggests that documentation is important to '*corroborate and augment evidence from other sources*' (p. 81). Additionally, a systematic search of documents is a vital issue in reducing selective bias (Stake 1995).

In the two case studies, various sources were utilised to provide not only an historical and unobtrusive view, but also an up to date perspective, in particular through 'surfing' the company's Intranet. In the BTC case, information was mainly documented in the electronic database according to events and various functional areas relating to the BPR programme. This enabled the researcher to obtain documentary information that was already categorised into various programme components. In the case of NatWest GFM, vital information relating to the GFM Millennium Programme (GMP) was mainly recorded on paper. This is because of the need to ensure that the regulatory parties could be provided with written proof when necessary. In contrast to BTC, the Natwest information focused on events and functional areas with information relating to the GMP categorised according to the IT systems used in the organisation. Hence, additional information that provided a synergistic view on the programme was collected from monthly and quarterly reports as well as memos.

3.4 The Data Analysis and Interpretation Phase

This section discusses the processes through which data analysis and interpretation led to the generation of a cross-functional knowledge integration theory. First, it highlights three types of coding -- open coding, axial coding and selective coding (Strauss and Corbin 1990) -- that were employed to reduce, organise and compare the data collected from each case. Secondly, it outlines how theoretical differences and similarities (Orlikowski 1993) across the two cases were revealed and analysed. Thirdly, it relates how a theory of cross-functional knowledge integration processes was generated from the data analysis and interpretation. Finally this section also discusses the issues of literature comparison, validation and thesis writing.

3.4.1 The Coding Processes

The large amount of data collected through interviewing, observation and documentation led to the danger of '*drowning in data*' (Anderson et al. 1995). Starting with the NatWest GFM case (the first case to be analysed), the first stage of data analysis was based on the concept of open coding in order to reduce the amount of data and to categorise according to various key concepts. As Strauss and Corbin (1990) explain, open coding refers to the process by which data are divided, examined and compared before they are conceptualised and categorised. With a primary focus on knowledge-related activities associated with the GFM Millennium Programme, this stage of analysis was more '*open-ended and generative*' (Orlikowski 1993) in comparison to that in the BTC case. In particular, the open coding technique, as used for content analysis, helped

to generate categories suggested by the data rather than imposed by other theories (Agar 1980; Turner 1983).

After all the data were examined and categorised, the second stage of interpretation and analysis was based on the concept of axial coding as a means of articulating relations between categories. Axial coding, according to Strauss and Corbin (1990), indicates a set of procedures by which data are reassembled in new ways after open coding and connections between categories made. Themes emerging from the open coding were used as a basis to re-examine the NatWest data. With a primary emphasis on the connections between categories, a more comprehensive scheme, capable of covering as much of the data as possible, was constructed by synthesising various categories and sub-categories. This iterative approach generated a new set of interconnected categories with related concepts that elaborated various knowledge integration activities and vital issues influencing the processes of knowledge integration in the cross-functional and broader organisational contexts. This fulfilled the requirements of multi-level analysis in studying the dynamic relations between processes and contexts (Pettigrew 1992).

Following the previous two stages of data interpretation and analysis, data from the BTC case were then coded based on the concepts and categories generated by the NatWest GFM data. However, difficulties emerged during the coding process, because the concepts and categories generated from the NatWest GFM site were not able to accommodate some of the findings surfacing from the BTC case. For example, the importance of the centralised implementation approach taken by the GMP team in ensuring similar progress between various branches was found to be less vital in the

BTC case. This not only forced a reconsideration of the NatWest GFM findings, but also called for a more abstract level of analysis capable of elaborating both the theoretical similarities and differences between the two sites.

In order to redefine the initial concepts and categories to accommodate the BTC case, the researcher returned to the NatWest GFM case and further re-coded and re-analysed the data based on selective coding. According to Strauss and Corbin (1990), selective coding refers to the process of selecting the core categories as well as subsidiary categories, integrating these categories, validating their relationships and refining the categories. Using this coding technique, richer concepts and more dynamic relations than those conducted during the axial coding process were generated. The ability to incorporate unique insights is reflected in the notion of '*controlled opportunism*', which, according to Eisenhardt (1989), refers to the way in which '*researchers take advantage of the uniqueness of a specific case and the emergence of new themes to improve resultant theory*' (p. 539).

In addition to the three coding processes elaborated above, this study also employed the cross-site pattern comparison and clustering approach suggested by Miles and Huberman (1984). In contrast to the three coding processes, that emphasise the integration of concepts, Miles and Huberman's technique stresses a balance between the similarities and differences between two or more research sites. Using matrix display, key cross-functional knowledge integration processes generated from the coding were compared, and the issues influencing the processes in one or both of the sites were also evaluated. The iteration between data and concepts ended when the stage of '*theoretical*

saturation' (Glaser and Strauss 1967) was achieved. According to Strauss and Corbin (1990), this is the stage where no new data seem to emerge in relation to a category, the category is fully developed, and the relationships between categories are well established and validated. Although theoretical saturation was achieved, this does not mean that the data analysis and interpretation processes were completed. The following section highlights the importance of comparing the current literature with the newly generated theory.

3.4.2 Literature Comparison and the Issue of Validation

After the process of open coding, this study started the first stage of the literature comparison. Only after the matrix display and selective coding were completed was a broad range of literature intensively compared with the emergent theory. The purpose of this comparison was to ensure that the new theory had a '*stronger internal validity, wider generalisability and higher conceptual level*' (Eisenhardt 1989, p. 544). An examination of the conflicting literature helps to enhance confidence in the findings and to exploit more alternatives in analysing and interpreting the data (Eisenhardt 1989). For example, in examining the concept of '*situated learning*' (Lave and Wenger 1991), contradictory findings suggest that the dependence on resources outside the project team greatly influences the dynamics of legitimate peripheral participation. Even though, in this study, there was a clear need for project participants to learn from the team members, the participants' dependence on resources forced the team members to obtain recognition from them, rather than vice versa. This is reflected in the argument of Eisenhardt (1989) that '*the juxtaposition of conflicting results forces researchers into a more creative, framebreaking mode of thinking than they might otherwise be able to*

achieve' (p. 544). This also mirrors the notion of using paradox constructively (Poole and Van De Ven 1989) and the idea of disciplined imagination (Weick 1989) in building organisation theories (Kirk and Miller 1986).

If well-constructed procedures of data collection and analysis are employed, then the resulting findings and generated theory may be regarded as empirically valid and reliable. This is because the new theory can both account for the uniqueness of each case and also generalise patterns across the two cases (Orlikowski 1993). Additionally, following Burgelman's (1983) example, cited in Eisenhardt (1989), this study applied the results to another four cases, as part of the DTI research project, to produce a broader organisational level of analysis. With the same focus on the processes of cross-functional knowledge integration, the extended research strengthened not only the theoretical scope, but also the validity, of the present study.

3.5 Thesis Writing

Starting with the stage of open coding, the first stage of the writing process concentrated on providing a detailed descriptive account of the two cases. Many drafts of the two cases were written and modified for the purpose of organising sub-categories and categories generated from the open coding. During this stage, drafts of the case reports were sent to the research sponsors of the two sites. Feedback from the sponsors varied in terms of the use of technical concepts as well as the way in which the data were analysed and interpreted. An analytical account of the two cases was written after the axial coding was completed. The case reports were then sent to the research sponsors for further

comments. Incorporating these comments with insights drawn from the current literature, a short version of the thesis (of around 20,000 words) was completed in September 1999. This was gradually extended, reshaped and refined as more thoughts were incorporated. In particular, the three coding processes have also placed great influences on the writing of the Literature Review chapter. Chapter Two was constructed through a continuous iterative process by which this study was able to present current literature in a way that elaborated not only theoretical similarities but also differences.

3.6 Conclusion

This section has elaborated numerous methodological issues relating to this study. The discussion of the philosophical stance explained the epistemological and ontological concerns that influenced the perspective taken in this study in understanding and investigating the chosen phenomena. In particular, the concept of social construction (Berger and Luckmann 1967; Glaser and Strauss 1967) helped to form the theoretical foundation of the study. The approach to understanding social reality by interpreting social actors' meanings and identities, as advocated by the social construction perspective, underpinned the design of the research as well as the methods employed for data collection. The work of grounded theorists, namely Glaser and Strauss (1967) and Strauss and Corbin (1990), greatly influenced the research design and objectives. From the start, the main aim was to generate a grounded theory capable of explaining the dynamic processes of cross-functional knowledge integration. Seminal work of Glaser and Strauss (1967), Yin (1984), Miles and Huberman (1984), and Eisenhardt's (1989) generative account of using case studies for theory building, provided a useful guideline

for shaping the research design. The choice of case study method provided not only flexibility in adopting multiple data collection methods (Yin 1984), but also the ability to articulate insightful stories embedded within the organisational context (Van Maanen 1979).

The construction of the case study protocol helped to clarify necessary procedures and to enhance the reliability of the chosen case studies (Stake 1995; Yin 1984). A pilot study of BP Amoco, based on the case study protocol, was conducted in 1998. The resulting lessons were useful for the subsequent case study research in four ways. First, the pilot study provided an opportunity for the researcher to gain first-hand research experience. Secondly, it suggested the importance of industrial background knowledge in understanding the stories provided by the interviewees. Thirdly, it helped to improve the research design and to increase the researcher's '*theoretical sensitivity*' (Strauss and Corbin 1990). Finally, the pilot study provided an opportunity to learn how to develop a relationship of mutual trust with the researched.

Based on the concept of theoretical sampling (Glaser and Strauss 1967), the selection of research sites emphasised the need to accommodate both theoretical similarities and differences (Orlikowski 1993). The synthesis of theoretical sampling and research objectives led to a focus on cross-functional project teams with dispersed team members and project participants. The problem of gaining access to research sites led to one of the most difficult, unforgettable, but also valuable parts of the study. In dealing with innumerable obstacles, the uncertainty and frustration of this part of the research process trained the researcher to be flexible and to appreciate the need for continuous learning

from experience. Often, solutions could not be found simply by consulting the textbooks.

The data collected through interviews, on-site observation and documentation were analysed systematically based on concepts of open coding, axial coding and selective coding (Strauss and Corbin 1990). The iteration between data and concepts helped the researcher not only to generate categories and sub-categories, but also to identify potential links between categories. Drawing on the analytical technique proposed by Miles and Huberman (1994), patterns that were unique to one case or applicable to the two cases were identified through matrix display. Such pattern-matching processes enabled the researcher to enhance the internal validity of the research findings (Yin 1984). One process that was interwoven with the data analysis and interpretation was the literature comparison. The purpose of drawing on the current literature intensively was not only to compare the emergent theory with similar theories, but also to contrast it with conflicting literature in order to ensure internal validity (Eisenhardt 1989). Additionally, the literature comparison served as a vital source of theoretical creativity (Weick 1989). Finally, thesis writing as a process of reflection helped enormously to balance the more descriptive accounts (Chapters Four and Five) and the more analytical account (Chapter Six). The following two chapters highlight the data collected from the two research sites.

Chapter Four- A Case Study of Boots The Chemists: The Business Process Redesign Programme

4.1 Introduction

4.1.1 Organisational Background

Founded in the late nineteenth century, The Boots Company is one of the UK's largest companies, with a turnover of more than £5 billion in 1998. The Boots Company is composed of seven organisations: Boots The Chemists (BTC), Halfords, Boots Opticians, Do It All, Boots Healthcare International, Boots Contract Manufacturing and Boots Properties. Out of a total of more than 83,000 employees within the group, BTC accounts for just under 60,000 of them and its sales alone amount to more than £3.5 billion per year. As the largest retail chemist in the UK, BTC has more than 1,300 stores on high streets or in out-of-town shopping areas across the UK and the Republic of Ireland. In the UK, more than one in ten of all prescriptions issued are dispensed by BTC. More stores are rapidly being opened in other European countries and throughout Asia, particularly in Thailand and Japan. In addition to central functions such as personnel, marketing and finance, BTC consists of three main business units -- Healthcare, Beauty and Leisure -- a segregation based along product lines. With the exception of their product focus, these three units are virtually identical in terms of their structures and business processes. Moreover, they all have their own marketing and financial personnel in addition to the central functions at the company level.

4.1.2 The BPR Programme: Background

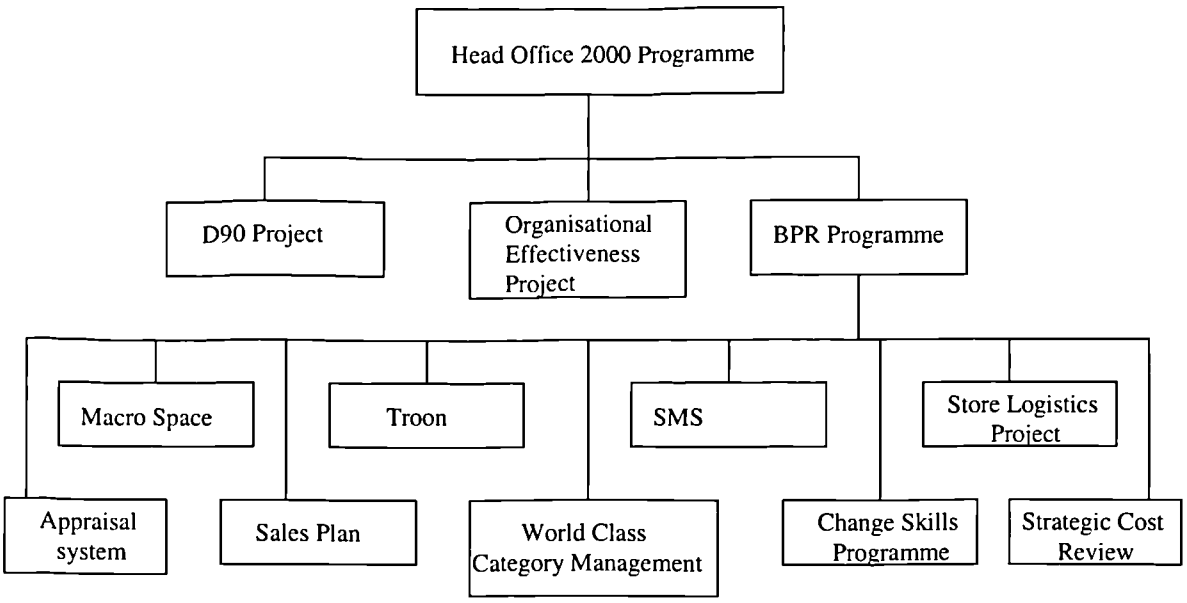
Along with the D90 project and the Organisational Effectiveness project, the BPR programme was initiated in 1996 as part of the Head Office 2000 programme to transform BTC into a leading world retailer by replacing the existing isolated practices of each unit with new and more integrative business processes. According to an internal report, the focus of the D90 project was '*where we work*', the Organisational Effectiveness project was concerned with '*how we act when we are at work*', and the BPR programme focused on '*what we do when we are at work*'. (See Figure 4.1 for the structure of these projects). These individual projects formed part of the Head Office 2000 programme which was designed to improve the ability of the Head Office to meet the needs of stores and customers:

> '*Our aim is to improve the quality of support we provide to our stores, to build effective relationships with store staff, to be more responsive to the need of our customers, to introduce better ways of working and remove complexity from our business.*' (Source: Head Office Report)

Triggered by external competitive pressures and an awareness of the need to improve internal organisational efficiency, fundamental changes were seen to be necessary. One key strategy of the Head Office 2000 programme was to change how the company works as a whole and how it responds to the external environment. A poll of the BTC staff showed how Head Office was perceived by members of staff. In response to the question '*what animal can best describe the Head Office?*' members of staff replied:

'a tortoise (slow but dependable, hibernates until Christmas) or a shire horse (traditional, English and good with children)'. (Source: Internal Survey Report)

Figure 4.1 The Structure of the Head Office 2000 Programme



In the hope of being viewed more as a *'tiger'* or an *'eagle'*, the BPR programme was initiated and the BPR team was formed by selecting members mainly from BTC as well as other subsidiaries of the Boots Company, such as Boots Properties and Boots Healthcare. The BPR programme, with a specific focus on business processes, was aimed at transforming BTC into a world class retailer by enabling the company to develop improved processes for all aspects of its business, including suppliers, Head Office, logistics, stores and customers. The BPR programme was composed of various interrelated projects including Macro Space, Sales Plan, World Class Category Management, Store Organisation, Store Logistics and Change Skills. These projects covered areas ranging from maximising profits to arranging product categories against

existing space, centralised criteria to measure the profitability of store space, the efficiency of sales promotion, and issues related to the Head Office and the stores. In all these projects there was an attempt to alter staff's mentality in terms of how change should be perceived. In other words, the aim of the BPR programme was to embed a new philosophy in the day-to-day routine of each employee. This is clear from the following explanation of the programme's aim as related by one interviewee:

> *'It is to move from day job and change as something separate, to making the change part of the day job. So when you come to do different things, you are able to cope with the new challenges. You don't think that it is extra work. Also, it is to make that change happen in the business quickly, efficiently and make it last.'*

4.1.3 The Interrelationships between the Projects

Despite the fact that the various projects that formed the BPR programme had their own foci, objectives and methods of implementation, they were all concerned with how profits could be maximised through collaboration between the stakeholders, in particular stores, suppliers and logistics. The interrelationships between the various projects were described by one of the team members involved in the Macro Space project as follows:

> *'For instance, between the Sales Plan project and the Macro Space project, the issues are "how do you allocate promotional space?" And "who allocates the promotional space?" World Class Category Management is, again, how do we work with suppliers to figure out at the end of the day*

how to sell the right amount of products through the right amount of space in our stores. Again, this [Macro Space] project looks at how our Head Office supports the regions and how the regions will pool the space in the store. So there is an overlap there. The project I am working on at the moment, Project Horizon, is related to property planning and overlaps with Macro Space.'

The interrelationships between the projects were created in numerous ways. Initially, this was done through the programme design. With the involvement of participants from virtually every department, all projects were designed to cut across departmental boundaries by establishing a programme structure that was like a matrix. Secondly, mutual dependence between different departments for resources also enhanced the interrelationships between projects. For instance, the Beauty, Healthcare and Leisure units relied on stores for space to sell their products, and the stores relied on the Beauty, Healthcare and Leisure units' expertise to achieve their sales targets. Similarly, the Sales Plan project relied on the Macro Space project for the allocation of promotional space, and the Macro Space project relied on the Sales Plan project for increasing profitability based on the existing store space. This mutual dependence provided the basis for synthesising resources that were dispersed within different departments in order to achieve the overall goal of the BPR programme. The interrelationships between projects were thus created according to the need for cross-functional integration and information sharing between projects.

4.1.4 BPR Team and Programme Participants

Two major groups of organisational members involved in the BPR programme could be categorised according to the roles that they played, as well as the degree of involvement in the programme. For the convenience of the following discussion, this study uses the term *core team* to refer to the BPR team, and *programme participants* to refer to organisational members who were involved in different projects on a part-time basis.

4.1.4.1 The BPR Core Team

The core team had around 12 members (15 during the peak) when the research was conducted with the number decreasing as the BPR programme drew nearer completion. With the exception of one member who was recruited from outside, the core team members, including the team leader who had previously worked for various subsidiaries of The Boots Company, were recruited based on their common expertise and experience in the area of business process analysis and project management. Even though common expertise was one of the main criteria, another vital issue in forming the core team was to choose members with diverse knowledge backgrounds as a means of stimulating discussion about alternative options for change.

With more than thirty-four years of experience in The Boots Company, the team leader was one of the most experienced members in the organisation. His extensive interpersonal network was argued by three team members to be one of the most vital 'assets' in influencing, persuading, and negotiating with various departments. With a philosophy of 'letting the members lead the team', his democratic and open leadership style was reflected in the role rotations within the team. The team was constantly

clustered and re-clustered into various overlapping groups with each of the BPR projects for the purposes of exchanging learnt experience. Each group had three or four members who were all members of the BPR core team. Normally, each group had the team leader, one or two more members who were responsible for the same project, and one additional team member who was in charge of another different project. The reason for such a combination was to ensure that the progress of each team member was enhanced through the inputs from the team leader and other team members. The team leader and the additional member's roles were to provide alternative thoughts and solutions, as well as to ensure that the members took all the required actions based on a standardised 'checking list'. The three or four core team members rotated the role of the group leader for various project-related meetings and events.

Located in an open-space design building block, the BPR team had easy access to departments both in surrounding buildings and in different parts of Nottingham. A relatively open and informal atmosphere was observed by the researcher, in particular in the way in which meetings were organised. Due to the amount of personnel involved in each project and the geographic dispersion of programme participants, it was often found that more than half of the core team members were not in the office. As one of the team members recalled, communication between team members could have been better, in particular during the time when there were 15 members in the team. It was hard to have time together and difficult to know what others were doing.

4.1.4.2 The Programme Participants

The number of organisational members that participated in each project varied substantially from around 8 to 25 people. Altogether there were more than 120 members of staff who were directly involved in the BPR programme, although their involvement varied in degree. Despite the fact that most of the programme participants were selected based on the specific expertise required by each project, in some cases participants were assigned by their departmental heads, rather than chosen by the BPR core team members. Occasionally, as explained by one of the interviewees, some organisational members participated in the BPR programme because they were the only people who were available in their departments during that period of time.

Each project was facilitated by one of the core team members, while vital information about the projects was shared within the core BPR team as well as within the project. Additionally, each project had a project manager who was selected primarily based on their position within the organisation and did not belong to the core team (with the exception of the Sale Plan project). Each project also had a steering group that was composed of senior managers who were directly involved in the implementation of each specific project. More details about the steering groups will be provided in the discussion of the programme implementation.

4.2 The BPR Programme and its Processes

4.2.1 Introduction

These interrelated projects started at various times during early 1998, and each was facilitated by one or two members of the BPR team with the exception of the Sales Plan project which was managed by one of the core team members. The BPR programme was divided into four phases, although in reality all four were highly conflated. The four phases were: pre-BPR preparation and the three BPR processes of planning, design and implementation.

4.2.2 Pre-BPR Preparation

During the initial stage of the BPR programme, an external consultancy team from PriceWaterhouse (now PriceWaterhouseCoopers or PWC) was brought in to evaluate business processes, costs and opportunities. This was in 1996. A team composed of BTC members of staff, who eventually became the core BPR team, was formed to shadow the PWC team. After evaluating the business processes, the costs of implementing BPR, and the opportunities for profit-maximisation, the PWC team left in December 1997. The BPR programme was gradually taken over by the internal shadow team (known as the core BPR team). In terms of the learning experience with the PWC team, most of the core BPR team members indicated that very little insightful knowledge in relation to the implementation of BPR was gained. All that was left for the core BPR team, according to one of the team members, was the database of business processes created by the PWC team. Although the PWC team had evaluated the potential value and cost related to the BPR programme, and had mapped the detailed organisation-wide business processes, the knowledge of how to achieve the programme goals and how to implement new business processes was not transferred to the core BPR team. One of the team members described his experience as follows:

'The whole idea was that internal consultants would be appointed to replace the Price Waterhouse team. There would be a period of time in which they would transfer skills to us in BPR methodology. Effectively, what happened was that when we were appointed in October and November 1997, the PWC team was coming to the end of its contract. During that time, we focused very much on producing tangible deliverables in accordance with the contract with BTC. We were doing a lot of work producing, flow charts and materials to support and back up the methodology, but very little on the actual skill transfer and training to those people who were introduced to the team.'

Due to the limited learning opportunities for the core BPR team, it was argued by most of the team members that they had to learn through trial and error. They used project management skills acquired from their previous experience and the information codified in the database to create new approaches to carry out the BPR programme. The following section considers the details of the planning, design and implementation stages, and examines the problems that arose in each stage.

4.2.3 The Processes of the BPR Programme

4.2.3.1 Introduction

There were three interlinked stages underlying the BPR programme after the pre-BPR preparation stage. First of all, there was a brainstorming session termed '*shaping the*

future'. Basically, the main purpose of this stage was to gather various thoughts and concerns from potentially affected business functions and project sponsors to form commonly acceptable objectives and to agree on the best way forward. The second stage involved the planning process of the BPR programme and was called the '*redesign stage*' by the BTC staff members. The aim of this stage was to actualise ideas and thoughts generated from the '*shaping the future*' stage and to formulate methods prior to the implementation of the BPR objectives. The aim of the implementation stage was to carry out the BPR programme according to the agreed objectives and methods formulated in the previous two stages.

4.2.3.2 Shaping the Future

4.2.3.2.1 Introduction

There were numerous events, including brainstorming sessions, creativity exercises, learning events and search conferences, in the first half of 1998. These events involved the main stakeholders: stores across 15 different regions, Beauty, Healthcare, Leisure, Marketing, Logistics, Information Systems, Personnel and Finance. Representatives from each business function were selected according to the expertise that was needed for specific projects. However, as noted above, it was not unusual to find representatives who were appointed by their departmental heads because they were the only available people in the department. Representatives were gathered according to the specific requirements of each project. The rationale for having representatives from each business function was fourfold. First of all, it was seen as a means of gaining the support of people who would eventually become the end users of the BPR programme. Secondly, representatives would use their functional expertise to express their

departmental concerns and disseminate the information gathered and lessons learnt from the BPR event into their business functions. Thirdly, the intention was to create shared ownership of the BPR programme through participation. Finally, the aim was to disclose, share and synthesise each business functions' expertise and use it as a basis for formulating a different way of working. It was agreed by most of the representatives that a radical, rather than incremental, approach was needed. As one interviewee explained:

> '*Instead of identifying incremental processes to redesign in isolation, we will fully align our resources behind the key projects on the strategic agenda, where our support is required*'.

4.2.3.2.2 Challenges and Problems Occurring During the 'Sharing the Future' Stage

Despite the fact that general agendas were agreed by most of the representatives during this stage, there were several problems that the core BPR team and other involved programme participants had to overcome. One of the most immediate concerns was to open up departmental boundaries to allow cross-functional discussions to take place. Broadly speaking, the organisation was divided into two major groups: the Head Office and regional offices. Within Head Office, business processes were divided according to business functions and product ranges such as Beauty, Healthcare and Leisure. Some of the interviewees referred to these as different '*silos*'. There were 15 regions across the UK, containing a total of 1,400 stores. Two interviewees explained that, with the exception of day-to-day business, which required some communication with other business functions, there were very few large-scale projects that demanded intensive

interaction across all organisational functions. At the regional level, one of the store managers stated that communication mainly took place within the region. Communication with other regions was relatively rare; usually this was with one or two neighbouring regions. The regional manager was the person responsible for communicating with Head Office. Store managers only met occasionally with members of staff from the Head Office.

Another problem was that there were numerous projects that were either in their initial stages or were actually being implemented in the organisation. Accordingly, competition amongst projects to secure the necessary resources, mainly money and people's expertise and time, and to keep the project on the top management's agendas, was intense. More importantly, as indicated by one of the interviewees, the sheer number of new projects with very little synergy in focus and resources made it impossible for members of staff to cope. This point is reflected in a statement in one internal report:

> *'BTC is suffering from "initiative overload" and/or inability to cope with change consistently and successfully.'*

Some of the interrelated *'initiative overload'* symptoms were clearly evident at this stage. First, there was the difficulty involved in ensuring that the project gained sufficient support from the top management and retained its priority. As one interviewee explained:

> *'Because there are so many projects happening, you have to fight constantly to get your project on their agenda. You might get your project on their agenda on Monday, but you can be*

sure that on Tuesday or Wednesday some other people or projects will come along and get on their agenda as well. So it is all about energy -- getting your project on people's agenda. They have just got too many projects.'

Secondly, sufficient resources had to be obtained to keep the project running. One of the most vital resources, according to the interviewees, was people's time and expertise. At this stage, all the projects were run in parallel with day-to-day jobs, and each business unit had its own financial target to achieve. Therefore, it was up to the departmental heads or managers to release their members of staff, who in turn had to balance the projects with their day to day jobs. Hence, one of the critical issues for the core BPR team was how to break through the departmental boundaries to secure the resources they needed for the programme. However, as two team members pointed out, before going to the redesign stage it was difficult to know whom they needed, when they needed them and how long they needed them for. Hence, the participation rate in every event depended heavily on people's availability. As one interviewee stated:

'When you know you are going to run a series of workshops for maybe half, one day or two days, you make it as short as you can. Otherwise, you won't get the resources you want.'

Thirdly, the different ways in which the value of the BPR programme was perceived by various departments and individual members also led to another series of problems. This issue was particularly evident in the different views of individuals on the best approach for maximising sales. At the same time, there was a variation in individuals' willingness

and commitment to participate in the project, and this also created problems. Hence, one of the major difficulties for the core BPR team was to accommodate the varying needs of different programme participants. As one of the interviewees explained:

> *"Some people are really keen to do that [the BPR programme]. For them the company is an exciting place to work. Other people will say 'no, that is not for me'. One of my jobs is to make sure both camps of people end up being happy."*

However, according to another core BPR team member, it was not at all easy to keep everyone happy, and to get every department involved. In one of the departments, the departmental head refused to release any person from his department to participate in any events at the planning stage. Actions taken by this department caused further conflicts during the following two stages.

Finally, there was the problem of obtaining sufficient support from potential users of the BPR programme. As two interviewees explained, due to the fact that the programme would have an impact on virtually every member of staff within BTC, the approval from the top management could do no more than ensure the launch of the projects. The eventual success of the BPR programme would depend on the level of participation and effective implementation. At the same time, the BPR programme proposed a radical change in the way members of staff worked and in their underlying assumptions and beliefs about how day-to-day business should be done. One of the problems which often

arose in relation to this issue was that some members of staff – especially those with long working experience within BTC -- did not believe the programme would work:

> *'We tried it thirty years ago, and it did not work. How can they be sure that their approach will work now?'*

Another example offered by one of the interviewees was that people often insisted that

> *'there is nothing wrong with what we are doing; why change things from what we are familiar with to something which we don't have a clue about!'*

4.2.3.2.3 Promotion, Persuasion and Negotiation

In order to overcome the problems outlined above, the core BPR team took a tremendous amount of time and effort to promote and persuade members of staff about the potential benefits of the programme. As some of the interviewees explained, it was also vitally important to foster a sense of emotional commitment to the programme. One interviewee stressed that the intellectual and emotional dimensions were interrelated and mutually reinforcing. Continuous promotion, persuasion and negotiation were employed to overcome the mental barriers that prevented the acceptance of new business processes and hence the BPR programme. Although some problems were solved at this stage, other problems persisted, and their impact gradually surfaced during the redesign stage.

4.2.3.3 The Redesign Stage of the BPR Programme

4.2.3.3.1 Introduction

On the basis of the objectives set during the '*shaping the future*' phase, the redesign stage aimed to formulate new business processes to meet those objectives. More fundamentally, the aim was to create a blueprint for the subsequent implementation stage. Within the redesign stage, several activities were highlighted. First, each business function's needs and interests had to be identified in order to draw up a commonly agreed set of business processes that could accommodate those needs. For example, a centralised promotion programme to cover the three product categories -- Healthcare, Beauty and Leisure -- was formulated. Secondly, this stage also served to investigate what contributions each business function could make to the BPR programme. For instance, the IS department helped the Beauty, Healthcare and Leisure business units to collect data on consumers' shopping habits according to products, geographical areas and age groups, through customers' store card details. The collection and analysis of these data depended on creating a close working relationship between IS, the Beauty, Healthcare and Leisure business units, the Marketing Department and the regions.

Thirdly, through communication with stakeholders from various business functions, an effort was made to find out what resources might be needed and how each function could support the implementation of the BPR programme. Finally, one of the most important tasks at this stage was to set up a standardised performance measure which could be applied to each store, product category and promotion activity. For instance, a store's profitability was measured by calculating rent, store space and sales; and a product

category's profitability was measured in terms of the space used to display the products, the cost of promotion, and profits generated.

4.2.3.3.2 Challenges and Problems Occurring during the Redesign Stage

One of the immediate problems to occur at this stage, according to the interviewees, was that one business unit refused to agree on the objectives set during the '*shaping the future*' stage. The department in question stated that this was because it did not participate in any of the decision-making processes, so it could not be expected to agree with the decisions made by other departments. The main disagreements were about how store space should be allocated, how store profitability should be measured, and how resources should be shared. Accordingly, on these issues, several objectives had to be modified in order to satisfy the requirements of the dissatisfied department. Even so, the debates and arguments about the design of new business processes continued, leading to a very tense situation. Eventually, two '*crisis meetings*' (the term used by one interviewee) were held between the departmental heads, the project manager, project sponsors and the top management. Two of the interviewees stated that this problem was rooted in inter-departmental barriers: the BPR was a cross-functional programme that required involved departments and business functions to open up their boundaries to allow information-sharing and communication to take place. However, the difficulties involved in achieving this aim had been underestimated. This negative impact of departmental and sub-unit boundaries was observed during every stage.

Another set of problems during the redesign stage arose from the fact that many stakeholders were not able to clarify what they wanted, why they wanted it and how business processes should be changed. For example:

> *"Some stakeholders said that 'I think the way we make change happen in the company is not good enough'. They are very clear at explaining what is not good enough. But they are not clear about what exactly they want. So a lot of time is spent on debating what is going wrong now. But this can't provide a coherent picture. That is not something you can specifically deliver. So you have a lot of issues around not getting real clarity, such as what they really want you to deliver and what it might actually look like in the company. That work is often very underestimated."*

Hence, the BPR team had to put a lot of effort into crystallising stakeholders' ideas and providing suggestions. This involved trying to make the stakeholders aware of why they were not happy with the current business processes. This made it easier for stakeholders to recognise the need for change. As one interviewee observed:

> *'People are happy with what they are doing, and they think they are doing a great job. So one of the issues is that you have to paint a picture to show them the facts and create dissatisfaction in the current status, which gives them the reason to change for the future.'*

Some interviewees indicated that they also challenged stakeholders' beliefs about certain working procedures by identifying the potential financial profits that new processes could generate. Faced with these challenges, stakeholders then found it easier to accept what changes were needed, why they were needed and what benefits would be.

Problems related to '*initiative overload*' were also observed at this phase. These were similar to those in the previous stage: securing resources, fighting for priority with other projects, and people's willingness and commitment. The combination of intellectual and emotional issues was again evident. One interviewee stated:

> "*People do not recognise there is a need for change. They are happy with their jobs and the rest of what is going on. If you come along and show them the facts and figures, and tell them that actually the world is changing and it is changing like this, then intellectually they can see that. But in their hearts they are feeling 'that is fine, but I still don't want to do it'. So you actually need to persuade them on the emotional level as well.*"

The approach taken by the BPR team to persuade the stakeholders at the emotional level was through involvement and the sharing of project ownership. One interviewee explained this in more detail:

> '*A lot of persuasion is achieved through involvement.... A lot of time they didn't think or they didn't engage in that, because they didn't recognise the problem. So you engage them first of*

all in acknowledging that there is a problem, that there is an issue. And then you ask them to start to think about how it might be different. Through that engagement, through thinking about that problem -- that issue -- and its possible solution, the answer to the problem becomes their idea. Even though you might present information which allows them to start thinking in a different way, it is their idea because it has come from them. So they are emotional about it.'

Involving members of staff in the process redesign helped to remove individuals' mental barriers to accepting the BPR programme. At the same time, by diffusing knowledge and information through departmental representatives, the BPR programme was introduced into the various departments. It was evident from what the interviewees said that information and the sharing of project ownership facilitated the breaking down of departmental boundaries. However, three of the interviewees said that this approach to achieving emotional buy-in did not work with some stakeholder groups, in particular some of the senior management. Because some of the senior managers had been working with the company for more than thirty years, they had seen how some business processes were developed, and they were convinced that things had to be done in certain ways. Not surprisingly, it was hard to persuade them to accept some of the new ideas. Two interviewees pointed out that several of the senior managers' views did provide useful insights for modifying the BPR concepts and drew attention to vital issues which had not previously been covered in the redesign stage. Incorporating these additional suggestions into the process redesign helped to achieve the intellectual and emotional

buy-in of the senior managers. Some interviewees stressed that the team leader and other senior figures had done a great deal to persuade other senior members of staff to support the new business processes. (A detailed analysis of how different views were settled is provided in Chapter 6.)

4.2.3.4 The Implementation of the BPR Programme

4.2.3.4.1 Introduction

In the next stage, each project team had to implement the new business processes formulated during the redesign stage. This involved organising a number of key activities: setting up project teams, forming steering groups, and replacing existing business processes with new ones. For each project, it was necessary to find sponsors, i.e. people who were directly affected by the new processes and occupied senior positions within the organisation. Proposals were reviewed and approved by the executives, and then each project was launched officially prior to implementation. Most projects started in the second half of 1998 with the remainder starting in early 1999. Steering groups consisting of representatives from each business function were set up. According to one of the interviewees, the role of the steering group was:

> *'To clear up the barriers which block the implementation of the project, to get the resources we need to implement and to support the representatives because they are the people doing the work.'*

Each project team consisted of several participants from various departments and one project manager working along with the steering group. The participants of each project

were recruited mainly on a part-time basis, with the exception of the project managers. A large number of the participants and the project managers had also been involved in the previous two stages. Two interviewees stated that in some cases, the recruitment of project members was based on the resources each business function could provide, rather than the skills required by the project. It was evident that the demands on project members gradually increased during the implementation stage. As one core BPR team member observed:

> *'I am the only full time member of the implementation team; everyone else is doing this as part of their day job. What I mean by that, is they have to do this on top of their jobs. They have no time release. They have in reality juggled a lot of their work. They have dedicated a lot to the project, which they would not normally do, in order to give it the time it needs.'*

Another set of activities at this stage aimed to transfer project management skills from the core BPR team to the project participants. A series of workshops and learning events was organised to provide opportunities for project team members to acquire communication, stakeholder management and process implementation skills. The workshops were also designed to enhance social interaction between project team members who in some cases did not know each other or had not worked together before. Despite the fact that most of the workshops lasted only a day or two, several participants regarded them as useful for acquiring the required skills and also for teambuilding. The importance of stakeholder management, according to one core BPR team member, was

that team members needed some knowledge to work with executives and senior managers in order to make the group feel comfortable with what the project team was trying to achieve. The rationale for equipping project team members with communication skills was explained by one of the project managers as follows:

> *'We need capability in understanding how to work with these different functional teams; what tools and techniques they need to use in order to get good answers from them; and how to get them to express their knowledge of the business in a way that allows them to identify some opportunities.'*

In parallel with implementation, another project initiative was the redesign of the appraisal system. This was seen as necessary in order to make effective implementation possible. As one interviewee explained:

> *'I think if I am not appraised, my incentive to do it is less because there is a disconnection between what the organisation wants me to do theoretically and what the organisation wants me to do practically.'*

During the process of implementation, the role of the core BPR team gradually changed. Based on the experience of the Sales Plan project (one of the earliest projects to be implemented), it was evident that having a core BPR team member as project leader was problematic because it caused arguments in terms of who was responsible for the project outcomes. Staff from the business units argued that this was the core BPR team's responsibility, and not that of the business units themselves, because they did not have

the project ownership. In order to avoid a prolonged debate and to reduce the projects' dependence on the core BPR team, the team's role changed from being the leading role of every project to being a facilitator. In other words, the core BPR team no longer shared the project ownership with any other project sponsors or team members (with the exception of one project). This was explained by one BPR team member as follows:

> *'In the past, they have put all the accountability on the project team outside their business. I don't think that works. I want to put the accountability on them. So they are demanding support to actually make it [the project] deliver. So they hold us accountable to give them the support they need to deliver what they need to deliver. And I think that is a much better way of doing it. Rather than us trying to push in on their agenda, I want them to pull us in and be demanding in that way.'*

4.2.3.4.2 Challenges and Problems Occurring during the Implementation Process

The problems and challenges that arose during the implementation stage were observed to have some similarities and overlaps with problems during the previous two stages. In some cases, unresolved problems from those stages continued to cause difficulties for the core BPR team and all other project participants. For example, it was argued by some of the interviewees that during the early stage of implementation, problems mainly revolved around the availability of people and how project priority could be established and maintained. One core BPR team member recalled that:

'To do the implementation, one of the most frustrating things is to get the right people, and release their time from their day jobs to take part in the implementation. That is why we have to draw a resource plan, so business will know who we want, how long we want them for and when we want them. The difficulty is until you know what you want them for, you don't how long you want them .... So it is hard at the beginning of your implementation to know exactly what you want and how you want it. It depends on how things develop.'

As in the redesign stage, the programme participants and core team members were constantly fighting to keep their projects on the top management's agendas. It was argued by some of the interviewees that instead of focusing on finding a link and synthesis between all projects, a lot of energy was consumed in just keeping the projects alive. On this issue, one of the reports stated that:

'Functional sponsors and others involved in change, have many competing priorities, which are being added to regularly. People involved in change will not see change as part of their day job. This leads to a feeling of frustration because you are working through people who are unable to deliver.'

This issue was also reflected in the level of support each project gained from the top management. As one interviewee explained:

'We don't get as much top management support. Even though we have executive sponsors for the projects, we needed to fight to get the projects on their agenda. The support from the company could have been better.'

At the same time, the way in which energy had been used in ensuring the survival of the project slowed down the progress of implementation. As one of the participants recorded:

'We did make good progress, but the difficulty is to devote all the efforts to make change happen. In particular, I have to be aware of other initiatives in BTC and ensure that our projects are on their agenda. That actually consumes energy that should be otherwise focused on making the change happen. It is a question of alignment really. So we make progress, but slow progress.'

In addition, personnel change during the implementation process also caused some problems for project teams, especially when new personnel joined in the middle of the implementation phase. The impact of personnel change on the implementation process was described by one of the core BPR team members as follows:

'First thing, the project manager changes. So the previous manager went through the redesign, did a good job and then found a new job somewhere else. The new project manager comes in, had nothing to do with the redesign phase, and is

still facing a steep learning curve. He has to make contact with all the stakeholders. Sometimes, you lose your momentum on the project, because the project manager needs to keep the momentum going to sell it. While the momentum is lost, this gives the opportunity to allow doubts to start to set in. Then you lose the enthusiasm, and people start to question.'

Another problem during the implementation phase, according to some of the project participants, was the lack of a holistic view across all projects. Projects were implemented in parallel, with no clear link between them, even though the interrelationships between projects were carefully considered during the redesign phase. According to the interviewees, the sheer number of projects proceeding in the organisation made it difficult to recognise them all and develop an integrated approach. As one interviewee explained:

'As we are moving forward, we are trying hard to make sure that what we are doing is not to "reinvent the wheel." However, it is hard to know all the projects which are initiated and implemented in other parts of the business and to make sense of how these project relate to your project. Sometimes, when you implement a project, there are other similar projects going on in the business that you don't even know about.'

Hence, efforts were put in to making the connection between projects. For instance, a central department was set up to co-ordinate between the Head Office and the regional stores the process of allocating store space amongst the Beauty, Healthcare and Leisure business units. One interviewee explained that there were seven space consultants working within the fifteen regions. Their responsibilities included the analysis of information collected from stores, measuring the profitability of each product category, and providing advice on how store space should be better arranged. Most importantly, they acted as a bridge between Head Office and the regions to collect and distribute vital information from one party to the other.

Another set of problems occurring during the implementation phase was related to changing people's beliefs so that they could appreciate that a fundamental change was needed. Despite the fact that the benefits of the BPR programme were promoted and communicated during the first two stages, a number of employees still found it difficult to incorporate the new processes into their day-to-day jobs. One of the interviewees argued that even though the external environment was changing rapidly, this did not necessarily mean that some old practices could no longer work. Another two interviewees argued that it was questionable whether it was worth implementing something which they were not familiar with, while at the same time discarding something with which they were familiar. It was further noted by one interviewee that in order to get people to accept the new processes, it was necessary to gain their trust:

> *'What I found is that it is a question of trust. People don't want to sign up to an overall goal if they think they are going to be blamed later on for not delivering against it.'*

In order to achieve the targets set by the BPR programme and to remove individuals' mental barriers to change (in particular the element of distrust), a new appraisal system was implemented in 1999. The rationale was to give members of staff the authority to set up their own targets and formulate their own strategies to achieve those targets. Individuals were then appraised on the basis of their own targets. This was explained by one interviewee in the following way:

> *'The learning we have from those projects is that in Boots, people find it very uncomfortable to have a goal without knowing how exactly they are going to deliver that goal. So they like to have everything planned before they will do anything. And what we want to do is try to get some stretching in the organisation.'*

With the introduction of the new appraisal system, members of staff were no longer told what to do and how to do it. According to some interviewees, this encouraged members of staff to learn and find new ways of doing things either through the new processes or by combining existing processes with the new ones. Two interviewees explained this further by saying that individual targets were consolidated as the group's target, which in turn were synthesised as departmental targets. Along with the new appraisal system, another initiative, called the Strategic Cost Review, was implemented as part of the BPR programme in the middle of 1999. This project aimed to reduce the company's overall operating costs by having individuals set up their own targets for cost reduction.

According to the BPR team facilitator of the Strategic Cost Review project, this task was difficult because they did not know

> *'How the hell we can actually remove those costs. Where are the solutions going to come from? Then to get people to sign up to an overall goal without knowing how we are going to deliver it. That is the biggest issue now.'*

Despite the fact that the new initiatives, the appraisal system and the Strategic Cost Review project were designed to accommodate constant learning amongst members of staff, there was an ongoing debate on how individual targets should be measured and what level of stretch should be taken. A further comment was added by one interviewee:

> *'They only want to sign up to something which they know they can achieve. And it is where we set up the level of stretch in the organisation, and what the level of trust in the organisation is that allows us to set up the level of stretch.'*

In some circumstances, where members of staff were not willing to accept the change or felt unhappy with the new business processes, they were encouraged to leave the organisation, even though this never actually happened. As one interviewee explained:

> *'For people who don't want to work here, they have every opportunity to find a different role, and to take the necessary payment or the redundancy type of package from the company to which they are entitled. So they leave in the right time frame with the right kind of financial package. So they feel*

happy to leave. So it is a conscious decision on their part to leave.'

Finally, another problem that had to be addressed during the implementation stage, although it had arisen earlier, was the issue of information and knowledge sharing across business functions. This was a complex task given the organisation's diverse structure across the 15 regions, even within each region there were numerous stores that reported to the regional manager. It was explained by one of the store managers that stores were the frontline interface with customers. Hence, Head Office in particular, relied on stores to feedback customer information, thus facilitating decision-making and strategy-formulation. However, before the implementation of the BPR programme, there was no mechanism to enable knowledge sharing across the organisation. As one of the participants involved in the Macro Space project observed:

'Certainly you might think we might learn as we make changes, and we don't. There is a lot of anecdotal evidence.... There is no mechanism to share that information and to disseminate that information across that region. A lot of local knowledge, a lot of knowledge generated by local retailers -- there is no mechanism for sharing that knowledge, which is a great shame'.

In order to overcome the lack of information and knowledge sharing between stores and the Head Office, a new IT system was introduced as part of the Macro Space project to allow the transfer of information collected by the stores to the Head Office, where it

would be analysed by internal space management consultants. The knowledge generated from this analysis was then fed back to stores as advice on how store space should be managed, and how products should be arranged in order to meet the needs of the local markets. Further detail was provided by one of the internal space management consultants:

> '*Basically, this tool kit provides local stores with guidance on information such as the local market, demographic information, competitors and so on to help the local store managers lay out their products and make the best use of the space in the store. This tool kit also helps to generate information from the local level and will be analysed by consultants and regional managers to monitor the performance of space and further enhance their strategy.*'

One of the store managers said that the advice from Head Office did help to improve the arrangement of store space, and provided valuable information on how other stores and regions were performing. But it was a demanding task to have to balance the sales of the three categories of products, instead of focusing solely on the overall sales turnover. As explained by one of the store managers, it would no longer be possible to have a large selection of one kind of product and not to display other products which were less popular in their stores. For instance, products such as vitamin tablets were particularly popular in certain customer areas and accounted for a large proportion of some stores' sales turnovers. Under the new system, stores had to arrange their product display in

order to ensure that there would be a minimum range of products which were known to be less popular in their stores.

One of the interviewees from Head Office argued that this system facilitated the efficiency of sharing vital information between Head Office and the stores. More importantly, as all the interviewees agreed, the new IT system did facilitate the removal of barriers between Head Office and the regions. This was evident in the involvement of participants from the regions in the BPR programme. However, despite the fact that the new system helped to bring together Head Office and the regions, the inter-regional barriers persisted. As indicated by one of the store managers, some regional managers and store managers were more active than others in communicating with neighbouring regions. At the same time, it was not unusual to have some regions where people were doing things in isolation without interacting with other regions. This evidence suggests that the new IT system did not, on its own, ensure increased information sharing between regions.

4.3 Emerging Themes from the Case

4.3.1 Introduction

Four interrelated themes that underlie the three stages of the BPR programme are illustrated in this section: penetrating departmental boundaries, sustaining project priority, changing individual beliefs, and modifying existing organisational practice. These four interlinked sets of activities were essential to facilitating the cross-functional

knowledge integration necessary for the successful completion of the BPR programme. They are analysed in more detail in Chapter Six.

4.3.2 Penetrating Departmental Boundaries

In terms of penetrating departmental boundaries, it is clear that before the programme could take place, the BPR team and other participants had to constantly communicate and interact with personnel from other business functions, including members of staff in the Head Office and the regions. However, the 'stickiness' of departmental boundaries (von Hippel 1994) and the difficulties in crossing them were evident in all stages of the BPR programme. Evidence suggests that interaction and communication across business functions served not only as a vehicle for promoting awareness of the BPR programme, but also as a mechanism to share vital information and knowledge that was critical to the redesign and implementation of new business processes. In particular, the redesign phase of the BPR programme relied heavily on achieving a synthesis of the various sources of knowledge embedded within the different business functions. Similarly, the implementation of the BPR programme depended on all business functions working collectively and openly. Without overcoming departmental boundaries, the various concerns and ideas advocated by each department could not be accessed and knowledge sharing across functions would be impossible. Without articulated and shared embedded knowledge, the planning, redesign and implementation stages of the BPR programme could not achieve their aims.

4.3.3 Sustaining the Project Priority

It was evident across the three phases that core BPR team members, as well as project participants, were constantly fighting with other projects to sustain their projects' priority and to ensure that their project was part of the top management's agenda. The rationale behind sustaining project priority was that vital resources, including people's expertise and time, were needed to keep the projects running. In addition, gaining support from the top management and the end users was indispensable for the success of the whole programme. Each project required resources not only for planning and redesign, but also for implementation. Without keeping a project at the top of the management's agendas and penetrating departmental boundaries to obtain sufficient resources, it could not possibly be carried through. Thus the BPR team and other participants had to constantly fight to secure their resources and ensure that their projects were given priority. As was evident across the three phases of the BPR programme, the effort to secure project priority was not a 'one-off'; rather, it was an on-going process in which all team members and participants were involved.

4.3.4 Overcoming Individuals' Mental Barriers

Another vital issue in relation to the BPR programme was the need to change the existing work procedures and replace them with a new set of business processes. In order to achieve this goal, individuals' mental barriers to change had to be overcome, so that the new ideas proposed by the BPR programme could be accepted. This involved not only promoting the potential value of the new system, but also persuading end users of the obsolescence of existing processes. It was also manifest that in order to overcome individual's mental barriers, intellectual and emotional 'buy-in' had to be achieved.

Intellectually, members of staff had to be persuaded about the benefits of adopting new business processes and of the inadequacy of the existing practices. Emotionally, it was vital to cultivate in end users a sense of belonging by involving them in the project and sharing project ownership with them.

4.3.5 Modifying Organisational Routines

Finally, the processes of BPR can be described as a series of activities that modified existing organisational routines. This made it necessary not only to generate new processes, but also to discard some existing processes. Furthermore, fundamental change in the organisational culture was also critical to the implementation of the BPR programme. Members of staff not only had to learn the new processes, but also had to unlearn some existing processes. New business processes represented organisational knowledge collectively constructed by members of staff through the creation of new knowledge or the combination of existing knowledge. It is clear that organisational routines were constantly modified through interaction and communication across functions, thereby externalising knowledge embedded within the various business functions. Even more importantly, new organisational knowledge was created by integrating various sources of embedded knowledge.

Further detailed analysis relating to these four specific issues is provided in Chapter 6 after the discussion of the second case in Chapter Five.

Chapter Five- A Case Study of NatWest Global Financial Markets: The GFM Millennium Programme

5.1 Organisational Background

The case company, NatWest Global Financial Markets (GFM), is part of the National Westminster Bank plc and was formed in 1997 from NatWest Markets. NatWest GFM provides a range of financial products, including foreign exchange, currency options, interest rate derivatives and other financial services, in London, New York, Tokyo, Hong Kong, Singapore, Madrid and other financial centres. The company's major competitors include Citibank, Barclays, Deutschbank, Goldman Sachs and J. P. Morgan. Despite its relatively small size, NatWest GFM was ranked first in sterling interest rate swaps and option products by *Risk* magazine (1998), and first in several interbank currency products in *Euromoney* and *Asiamoney* (1998). A total of 1,100 employees generated £393 million global profits before tax in 1998, an increase of 61% on the 1997 results.

5.1.1 NatWest GFM's Business Process

One way to understand how NatWest GFM operates is to look at the procedures through which each transaction is made. Three business functions are involved: front office, middle office and back office. The front office, where the trading floor is located, is in charge of buying and selling financial products for customers. The back office is where payments are settled. The middle office is responsible for tracing and checking the

match between trading and settlement as carried out by the front and back offices. Each business function has its own unique working procedure and specific knowledge that is needed to fulfil the job requirement. Similar arrangements can also be found in overseas branches, although the scale is much smaller than in the London head office.

5.1.2 Organisational Structure

According to NatWest GFM's organisational chart, the company consists of six departments: Technology, Business, Infrastructure, Human Resources (HR), Research and Finance. An alternative way to understand the organisational structure, as is the common practice in the company, is through NatWest GFM's financial product ranges. Each product range has its own staff, including traders and technologists, as well as a hierarchical structure in which reporting lines are established and responsibilities are delegated. Since there are major differences between product ranges and their technological requirements, the Technology Department is divided according to the product ranges it serves. The three major business functions discussed above are applied to each product range. This means that each product range has its front, middle and back office staff, as well as its front, middle and back office supporting technologists.

As the result of an unknown historical decision, the London HQ was divided into two sites -- one located in a building in Bishopsgate (right outside Liverpool Street Station) and the other based in Kings Cross House (near Kings Cross Station). For the sake of convenience, the name Bishopsgate will be used here to refer to the London HQ unless there is an explicit statement to the contrary. Kings Cross House has the major back office function, such as payment settlement, as well as back office supporting

technology. The rest of the head office staff are located in Bishopsgate. These include the front office, the middle office, their supporting technologies and other business supporting functions such as HR and Infrastructure.

5.2 The NatWest GFM Millennium Programme

5.2.1 Programme Background

According to the regulations of the Bank of England and the Financial Services Authority, as well as other overseas regulatory parties, it was compulsory for every bank operating within and outside the UK to ensure that its IT systems were millennium compliant before the end of 1998 and that there would be continuity of business operations in the event of an unforeseen millennium crisis. The NatWest GFM Millennium Programme (GMP) was initiated in 1997, with an expected completion date of March 2000.

The GMP consisted of two major sub-programmes: millennium compliance and business continuity. The major tasks of the first of these sub-programmes were as follows:

(1) to identify all individual systems used in NatWest GFM;

(2) to map the interrelationships amongst the various systems, including those networked with other parts of the NatWest Group and other financial institutions; and

(3) to test and prove that these systems were millennium compliant.

The business continuity sub-programme sought to ensure that the company's business operations would still function continuously even if a disaster occurred. Its three major tasks were:

(1) to identify the processes through which the business functions;

(2) to formulate alternative options to sustain business activities, e.g. an alternative site, manual tools, and possible actions;

(3) to ensure that every employee in NatWest GFM knew what to do if crisis should occur.

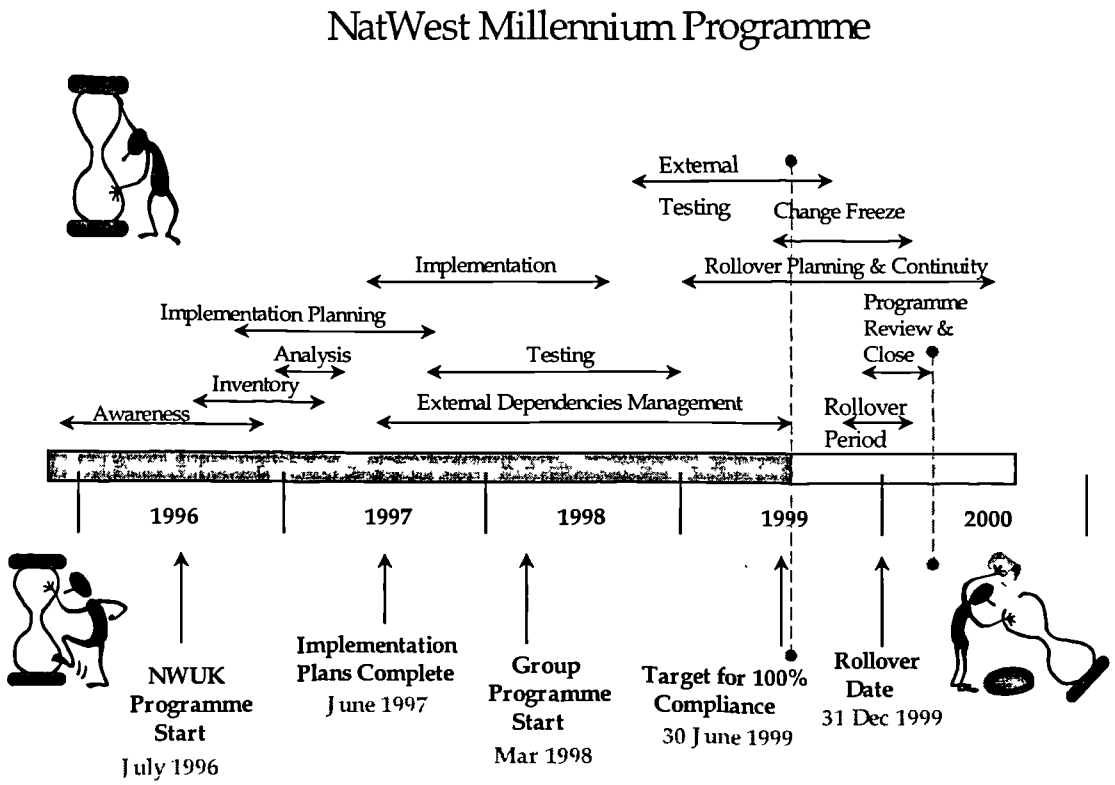
5.2.2 Programme Scope and Coverage

Due to the requirements of millennium compliance and business continuity, the GMP initially involved virtually every member of staff in the organisation. Even though the London HQ had most of the company's business and operations, the GMP was applicable to every NatWest GFM branch around the globe and covered not only internal organisational units but also external parties. Internally, issues related to IT applications, IT infrastructure, end-user computing, premises, and client and regulator enquiries were all included within the GMP. Where these issues involved external parties, they were also included. For example, NatWest GFM has a number of service providers within the NatWest Group. As explained by the team leader, part of Greenwich NatWest provides back office interest rate derivatives technology and services to NatWest GFM. Other parts of the NatWest Group are responsible for NatWest GFM's cash management and cash transfer mechanisms. That is why, he added:

'We treat them as though they are just another development team. Mentally we take pretty much the same approach to them as if they were part of NatWest GFM.'

The GMP, with a life-span of up to three years, was described by the interviewees as the longest programme ever undertaken in GFM. Figure 5.1. provides more detail about the division of the project into distinct stages.

Figure 5.1 NatWest Group Millennium Programme (Source: NatWest Internal Document, 1999)



The two major foci of the GMP in 1998 (according to the GFM Millennium Programme Overview of the 1999 Millennium Plan) were as follows:

1. Identifying, analysing for year 2000 (Y2K)-related issues, amending or replacing IT systems followed by millennium testing. The work has been within the following areas:

- IT applications;
- IT infrastructure;
- end-user computing;
- premises; and
- managing client and regulator enquiries.

2. Assessing the millennium compliance preparations of the branch's clients.

From 1999, the GMP aimed to address non-compliant situations and to shift the emphasis from becoming compliant to maintaining compliance and monitoring clients' millennium preparations and credit policy. Other initiatives, as part of the GMP, included millennium business continuity planning, millennium rollover planning, contract reviews and external testing. Table 5.1 lists the various milestones identified by the GMP team.

The scope and coverage of the GMP have made it difficult both to draw a boundary for the programme and also to differentiate clearly the GMP core team from its participants. For the purpose of simplification, future references to the GMP core team will here refer to the individual members who were involved in the programme on a full-time basis, and references to the programme team will refer to both the core team and those

organisational members who were engaged in the programme on a part-time or voluntary basis.

Table 5.1 The key milestones of the Y2K project (Source: NatWest GFM)

1	Address Non-compliant Situations
	• All Components Compliant – June 31, 1999
2	Maintaining Compliance
	• Complete Millennium Regression Test of All Systems – September 30, 1999
	• Commerce Mandatory Change Freeze – October 1, 1999
3.	Millennium Business Continuity
	• Detailed Plan Agreed by All Business Areas – March 31, 1999
	• Detailed Plan Validated – June 30, 1999
	• Activate Contingency Activities to Address Failures in Plan Validation – June 30, 1999
4.	Millennium Rollover Planning
	• Detailed Plan Agreed by All Business Areas – March 31, 1999
	• Detailed Plan Validated – June 30, 1999
	• Activate Contingency Activities to Address Failures in Plan Validation – June 30, 1999
5	Contract Reviews
	• Key Suppliers' Contracts Reviewed – March 31, 1999
	• Supplier Support Commitments Confirmed – June 30, 1999
	• Escrow Review Complete – June 30, 1999
6	Millennium External Testing
	• Issues External Testing Schedule – February 28, 1999
	• Issues External Testing Plan – March 15, 1999
7	Credit Risk
	• Issues Revised "At Risk" Register – Monthly

5.2.3 The GMP Team

Formed in early 1997, the core team was composed of nine full-time members in the London head office and three in the New York branch. Some personnel changes occurred between February and May 1999, as two members left between March and April and three members joined in February, April and May 1999. The nine members constituted the core team based in the London HQ. In addition, there were numerous

members in various regions who also took part in the GMP and directly reported to the team leader or the London-based team members.

5.2.3.1 The Team Leader

With 13 years experience in the NatWest Group, the team leader had strong background knowledge of the company's technology and business operations, as well as a broad personal network. His responsibilities expanded from the millennium compliance activities to other related areas such as IT security, IT change management, and business continuity in February 1999. His involvement in the GMP earned him the title of 'Mr. Millennium' in NatWest GFM.

The team leader enjoyed a reputation for being 'rigid', 'tough', 'bureaucratic', 'authoritative' and 'straightforward', and most of the interviewees agreed that 'you need people like Paul [the team leader] to do this job'. As several team members confirmed, the leader's style was 'supportive' and 'laid back'. The leader himself stated that 'you should give people enough rope to hang themselves'. According to his experience in delivering project milestones, one of the key challenges was to ensure that team members faced minimum communication barriers during the implementation process. (More details concerning the removal of communication barriers will be highlighted in the subsequent discussion of the implementation stage.)

Additionally, the team leader was also responsible for recruiting his team members. In this respect, his two guiding principles were: '*pick the man for the job, don't model the job to fit the man*', and '*they must have a degree of passion about what they are doing*'.

As explained by the Global Head of Human Resources, one basic criterion of selection was that 'recruited people need to be academically talented and excellent at interpersonal skills'. He further added that the recruiting process aimed 'to pick out one racing horse from a pack of 99 donkeys'. The team leader also believed that he was responsible for helping to develop team members' skills and their careers. However, this was applicable only to permanent staff not contractors. Further discussion of the role of contractors will be provided in Chapter Six.

5.2.3.2 Team Members

Amongst nine London-based team members, there were seven contractors and two permanent members of staff, one of whom was recruited for the business continuity sub-programme in May 1999 and left a few months later. There was a significant turnover rate during the first half of 1999. One of the contractors left the organisation and the other joined the team only a few days before the study began. During the period of research, three new members joined and one member left. The nine members shared a common expertise background in project management and information technology, with variations of knowledge in millennium compliance and business continuity. A few of them had previously worked in the investment banking industry, and some had participated within similar projects before joining NatWest GFM. These London-based team members were divided into two groups: one for the Millennium Compliance Programme and one for the Business Continuity Programme. The responsibilities of the millennium compliance group were further divided into the front office and back office systems.

Within the London Head Office where the core team was co-located, a relatively open and friendly atmosphere was observed by the researcher, even though it could get very quiet and serious when the leader and the other senior team member were around. Sitting in an open space, informal conversation across desks took place frequently, and quite often team members and the team leader joked amongst themselves. Team members took turns getting drinks for the whole team, depending on their workload. Despite the fact that each member was very busy with his own work, everyone was happy to help other members of the team to solve problems and answer questions. One permanent member of staff and one contractor had relatively long experience within the organisation. They not only provided information on technological issues, but also shared with new members their experiences in dealing with other people in the organisation. In some cases, when the new members were going to meet someone they had not contacted before, the experienced members helped them prepare for the meeting by telling them something about the person in question.

The above discussion has outlined the nature and scope of the GMP, and given some background information on the team leader and team members. The following description will concentrate on the initiative, implementation planning and implementation stages of the GMP. The major activities and challenges of each stage will be highlighted.

5.3 The NatWest GFM Millennium Programme (GMP) and Its Processes

5.3.1 Pre-GMP Preparation: The Initiative Stage

Before the GMP commenced in 1997, a group-wide Millennium Programme was launched in July 1996 (see Figure 5.1.). There was thus more than a year of preparation for the GMP. The team referred to this as the initiative stage. There were two major activities during this stage: the promotion of Y2K awareness and the recruitment of external consultants to investigate system inventory. Since the early 1990s, an enormous amount of media coverage had promoted the concept of Y2K compliance and helped to raise awareness of the issue among not only technologists but also the general public. This greatly helped the GMP team to promote the concept of Y2K compliance to all organisational members. In early 1996, this promotion of the Y2K issue was officially launched at both the group and company levels. At this time the company was still known as NatWest Markets; NatWest GFM was not formed until 1997. The promotion of Y2K awareness emphasised primarily the technological issues and the importance of Y2K compliance to the company's business reputation.

Towards the end of 1996, an external consultancy team was brought in to undertake a feasibility study to estimate the key deliverables of the Y2K programme. These deliverables, according to the team leader, included what needed to be done, how much it was going to cost, how many resources were needed, and a very simple list of what was required. Through this feasibility study, the consultants identified the IT systems used in the company and estimated the potential cost and required resources by

interviewing some of the system managers. Based on the experience of system managers in relation to the time and resources required to make their systems compliant, the external consultants were able to produce an estimated overall cost.

5.3.2 Major Challenges Faced by the GMP Team

Despite the fact that the outcome of the feasibility study was 'pretty nearly spot on', in the words of the team leader, there were some unforeseen problems which did not surface until the end of the initiative stage and the beginning of the implementation planning stage. In the leader's view, '*it [the feasibility study] is such a high-level exercise that unless you do it right, the answer can be widely out*'. He provided one specific example:

> '*I asked a chap "how much will it cost to make your system compliant?" The individual answered "it will be about 3 to 9 months and cost around £20,000". When we did the work (system analysis) properly, we realised that it would take two elapsed years just to make that system millennium compliant*'.

In trying to explain the difference between the system manager's judgement and the real time required, the team leader commented that the problem was due to the inappropriate way in which questions were constructed and asked. System managers often misunderstood the questions by only taking into account the time they would need to make their systems millennium compliant, and did not consider the time required by the system vendors, if systems were purchased from external sources.

Similar problems gradually emerged when a detailed analysis based on intensive interviews with system managers was carried out by two of the GMP team members at the very end of the initiative stage. The recognition of such problems indicated that to make all systems millennium compliant would certainly take more time and resources than had been suggested by the original feasibility study. Some of the estimated costs provided by the external consultancy team were clearly inaccurate and misleading. This suggested that a detailed inventory of all systems would be needed in order to ensure that an accurate plan could be drawn up for planning and implementation. This study, based on interviews with system managers, started in early 1997 and was completed by the end of 1997.

5.3.3 The Implementation Planning Stage

5.3.3.1 Introduction

The implementation planning stage started in June 1997 and was completed in December. Following the efforts made during the initiative stage, a detailed inventory was gradually expanded until nearly the end of the implementation process. This inventory served not only as a guide for implementing planning, but also as a foundation for a centralised database to which information collected during this stage and the implementation stage could be added. An implementation plan based on the inventory was proposed by the GMP team. This included the milestones which needed to be achieved before December 1998. This was an official deadline, provided by the regulatory parties, for the completion of the first phase of millennium compliance. Detailed activities for 1999, with the emphasis on business continuity, maintaining

millennium compliance, and the millennium rollover period, were also outlined during the stage. Further details of some of these activities are provided in the following section.

5.3.3.2 Major Activities of the Implementation Planning Stage

5.3.3.2.1 The Expansion of System Inventory

As explained above, one of the primary objectives of the GMP was to extend some of the efforts made during the initiative stage in order to build a system inventory based on identifying existing systems and mapping the interrelationships among those systems. Two team members were assigned as project managers to accomplish this task, one responsible for front office systems and the other for back office systems. These two key members teamed up with other London-based and overseas members to identify the systems and their users, and to determine how the systems were used in various business functions according to product ranges. In order to gather such information, these members had to equip themselves with relevant background knowledge about both technology and business operations. Further details of this issue will be included in the discussion of challenges faced during the implementation planning process.

The information collected and lessons learnt by these members had to be codified into a database. Because the development of IT within GFM was evolutionary rather than static (as one interviewee put it), the two members were faced with the challenge of keeping track of continuous innovation and modification, and of codifying relevant information in the database. Despite the fact that a very large amount of data was collected during this stage, the expansion of system inventory was not finished.

Information was collected continuously during the implementation stage, and the system inventory was consistently expanded along with the progress of the GMP.

5.3.3.2.2 The Introduction of Documentation

Another vital approach incorporated with the expansion of system inventory was the introduction of documentation. As one of the few supporters of this practice, the team leader explained why such documentation was critical to the GMP:

> *'Because to make a system millennium compliant is one of the easiest things in the world, but to provide demonstrable proof which gets filed away is one of the hardest things in the world. So everything we have done is documented.'*

The approach to the documentation process was further explained by the team leader as follows:

> *'The majority of information is held in the files which are seen on the shelves, and the open section two in every one of those. Each file relates to a system open section two in every one of these, and it holds exactly the same type of information in the same structure. So if we want information, we know exactly where to get it. And it is exactly the same in New York and Singapore.'*

As one director explained, this documentation procedure '*is not a particularly common practice in GFM*'. However, according to his experience, '*there is no excuse for having no documentation at all*'. On the other hand, he felt there was a danger that documentation was too time-consuming for an environment in which change was rapid. Another director commented that in his opinion documentation was not of much value to the business, since most people would not use it and would not put much effort into it. This highlights one of the main challenges faced by the team: a lot of vital information, in particular that related to system modification, had not been fully recorded in the past. To trace such information was an enormous problem for the GMP team. Further discussion of this issue follows in the next section.

5.3.3.3 Challenges Arising during the Implementation Planning Stage

5.3.3.3.1 The Diversity and Complexity of IT systems

The sheer number of IT systems used by the organisation and the voluminous links between those systems meant that it was extremely difficult to formulate an accurate implementation plan. The IT systems employed in day-to-day business varied not only between the front, middle and back offices, but also from product to product. In addition to office- and product-specific systems, there were also systems which networked these three offices for various products. Furthermore, GFM's global operations also indicated another layer of IT diversity. Despite the fact that a large number of financial products in different branches used similar IT systems, there were also significant variations resulting from the need to respond to distinct local markets. Systems that connected various branches with the London head office also increased the IT complexity. Various inter-organisational systems were also used. For example, the front office had systems

for accessing price quotation information for financial products, receiving client requirements on specific structured products, and providing advisory services to clients.

Systems with standard applications had been developed and modified gradually. The handbooks provided by software houses could no longer offer valid information about the application of the systems. For custom-built systems, no handbooks had ever been produced. Developers and end-users, as the major parties involved in the development process, were the only people who had the necessary knowledge about the implications of each system and details of system modification. Therefore, relevant information was available only from the developers and the end- users. As indicated above, because the details of system modification were not fully recorded during the development process, to obtain such knowledge was difficult and time-consuming. In some cases, the information had been lost or the knowledge had been forgotten. Differences in the knowledge backgrounds of the technologists and end-users also pointed to another challenge for the GMP team members, as will be explained in the following section.

The modification of IT systems was ongoing, except during the period of '*change freeze*'[4] from October 1999 to January 2000. Therefore, even systems that were millennium compliant still required a constant effort to maintain their compliance status. Constant interaction with the developers and end-users was thus vital if the GMP team members were to keep track of the modification of IT systems.

5.3.3.3.2 Differences in Knowledge Backgrounds

Differences in knowledge backgrounds between the technologists and the end-users led to further problems in building the system inventory. As explained by the Head of Technology, in the investment banking industry employees responsible for the business function and those responsible for the technology function often lack the knowledge necessary to understand each other's needs:

> *'This is because technology in its own right is a very interesting business -- just to be a technologist. But to be a technologist who understands investment banking and understands where you need to build is incredibly difficult. The real issue in installing technology is that the users don't really know what they want. So the traditional model of "business requirement, design, develop, test, implement" doesn't work in investment banking.'*

In order to overcome this problem of differences in knowledge between the two communities, the development and modification of IT systems were designed to incorporate the efforts of both technologists and end-users. In other words, each IT system was developed and modified through collaboration between the two communities. In addition, training courses -- such as on-the-job training, financial products, IT and management development -- were provided by the organisation as a means of closing the knowledge gap. Employees' training data, provided by the Global Head of Human Resource, indicated that the technologists and the end users had

[4] 'Change freeze' refers to a period of time in which no systems were allowed to be installed or modified.

actively participated in these courses in order to gain business knowledge, and that end-users had taken the courses to enhance their technological knowledge. Although these efforts were undoubtedly beneficial for the development of IT systems, they created some difficulties for the GMP team members in codifying the knowledge created during the development process. Two team members explained that in order to understand why each IT system was developed and modified, it was necessary to appreciate both the technological and business dimensions. In practice, neither the technologists nor the end-users could usually provide a complete picture of the modification process to the team members. Hence, the team members did not find it easy to make sense of the explanations provided by the two groups. Not surprisingly, the two members argued that it would be extremely difficult to build an accurate system inventory.

5.3.4 The Implementation Stage

5.3.4.1 Introduction

Soon after implementation planning was completed in December 1997, the GMP entered its implementation stage in January 1998, with an expected completion date of March 2000. The majority of GMP team members were recruited during early 1998 to cope with the increasing workload. The core GMP team expanded from three to nine members (the number was constantly changed during the implementation stage). The primary activities relating to implementation, in addition to the recruitment of new team members, were: the introduction of a global standard procedure for implementation, conducting the systems' millennium compliance testing across its global operations, and the introduction of the business continuity programme in early 1999. The three main challenges faced by the GMP team were: overcoming the team members' learning curve,

breaking down communication barriers, and gaining programme priority. These will be discussed further in the following section.

5.3.4.2 Activities During the Implementation Stage

5.3.4.2.1 The Recruitment of Team Members

According to the team leader, the increasing workload in early 1998 triggered the expansion of the GMP team. During this period, only contractors were recruited. Only the team leader himself and one other staff member were permanent members of the GMP team. The rationale behind this recruitment policy was explained by the team leader:

> *'It could be very hard for anyone on another Millennium team or indeed any Millennium team to fill another full-time post again within the same organisation. This is primarily because we are seen as being enforcers of something that most technicians do not want to be doing. So we are seen as a pain in the ass. It will be very hard for people at this level to slot back into a team.'*

Other reasons for employing a large number of contractors in NatWest GFM in general were explained by senior managers. For instance, one of the interviewees observed that:

> *'When your project changes its shape, size and scale, you can bring in new contractors to meet the new shape, size and scale.'*

Another senior manager explained that '*contractors are far more easy to get rid off than permanent staff*'. Another manager stated that '*sometimes it is too expensive to develop such expertise in-house and it can often be inefficient to do so*'. Despite its advantages, some interviewees stressed that the system of having a large number of contractors was certainly not a '*panacea*'. One manager stated that when contractors left the organisation, this was '*a great knowledge loss to GFM*'. However, not every interviewee agreed with this view. The Global Head of Human Resources indicated that:

> '*One of the peripheral roles in the organisation is to extract from the contractor the knowledge which must continue after the contractor has gone, and certainly it is not an unreasonable proposition that the line manager is responsible for extracting the knowledge from these people.*'

With such a high proportion of contractors, the GMP team leader explained that a certain degree of knowledge loss to the team was inevitable. This is why the GMP team needed to document all the lessons learnt and knowledge articulated during every stage of the programme.

According to the team leader, the recruitment of team members was based on three major criteria: the ability to document, the ability to communicate clearly, and the individual's passion towards their work and interaction with other members in the organisation. In order to communicate effectively with other programme participants, especially the technologists and end-users, newly recruited members were required to

have substantial background knowledge of both business and technology. This was why the team leader insisted on the principle '*pick the man for the job, don't model the job for the man*'.

5.3.4.2.2 The Introduction of a Global Standard Procedure

As indicated above, the diversity and complexity of IT systems in NatWest GFM created numerous difficulties for the planning and implementation of the GMP. In addition, GFM's global operation also gave rise to another level of difficulty, since it was necessary to ensure that every branch would achieve the same expected milestones within the proposed deadlines. This inspired the GMP team to adopt a global standard procedure for the implementation process, instead of allowing branches to implement the programme in their own ways. The rationale for adopting such an approach was summarised by the team leader as follows:

> '*You should require and demand that level of standardisation across the board, and it should not be open for negotiation. People outside the head office should be told to do it.*'

According to the team leader's experience, providing overseas branches with flexibility did not always produce the necessary standard:

> '*We told people to do it. They sat there, they nodded and they said "yea, yea, yea". By the time you were on the plane to the next branch, they were doing their own thing again.*'

The agreed standard process enabled the GMP team to implement the programme on a global scale without facing the problem of integrating regional differences in implementation approaches. From the management point of view, this global standard procedure helped the team to ensure that overseas branches achieved the same standard and requirement as the London head office. Combined with the documentation approach described above, the GMP team was thus able to ensure that all evidence was collected from every branch in exactly the same way.

5.3.5 Millennium Compliance Testing

As the major block in the implementation stage, the majority of testing for internal IT systems was conducted and completed during 1998, with the remainder conducted during early 1999. IT systems networked with other external systems were tested mainly during the second half of 1998 and early 1999. Despite the fact that the GMP team had no control of these external parties, it was stressed by one team member that the team remained responsible for the overall success or failure of the programme. Hence, it was vital to ensure that external parties collaborated for millennium compliance testing. With this aim in view, one part of the GMP programme was called '*credit risk*', and its objective, according to an internal report, was to:

- Monitor counterparts in order to identify those that should be considered 'at risk' based on deficient response to enquiries as to their Y2K preparedness in addition to recommendations provided by the business units that own the relationships.
- Review 'at risk' counterparts on an ongoing basis, revising credit facilities as appropriate.

The following discussion highlights the major challenges faced by the GMP team during the implementation stage.

5.3.5.1 Challenges Faced during the Implementation and Testing Stages

5.3.5.1.1 Overcoming Team Members' Learning Curve

During the implementation stage, the new team members faced a steep learning curve. Disruptions in the implementation of the GMP resulted not only when contractors left the team, but also when new members were recruited. Even though most of the new members had gained sufficient experience in technology and business in their previous jobs, there were still new 'vocabularies' and 'languages' to learn. Specifically, lots of pet names were used to refer to various IT systems in the organisation. The new members also had to become familiar with the various types of system modification that had been made during the past few years. In this respect, the information and knowledge documented in the database was of great assistance to the newcomers. As two newcomers explained, the database enabled them to take over the project in less than a month. This was important because they could not afford to spend too much of their contract periods on learning about the GMP without making contributions to the programme. However, although the database information was useful, the personal experience acquired during the implementation of the GMP was not recorded. This meant, for example, that finding out who would have the necessary information and understanding was a process of trial-and-error. Even though team members could share their experience amongst themselves, there were still difficult situations in which new members found it difficult to apply the knowledge shared by the experienced members,

in particular the type of knowledge that could best be acquired through their social networks.

According to the new members, technical knowledge was not the most difficult problem on their learning curves. Rather, the main challenge was to know how NatWest GFM functioned, what were people's expectations, and whom they should speak to in order to get their work done. One member summarised this challenge by saying that it was all about 'the politics in GFM'; another member stated that it was about learning how 'to get on with others'. Despite the fact that experienced team members had became one of the primary sources for obtaining vital information and knowledge, this solution did not always work for the new members. In particular, when issues were related to existing personal networks in the organisation, the experience shared by other members was not always accessible to the newcomers (who did not belong to such networks).

It was not easy for newcomers to gain the acceptance of other team members, particularly permanent staff. Furthermore, acceptance in professional terms was not the same as social acceptance. There was, in particular, a gap between the permanent members and the contractors. This clearly reflected the comment by the team leader that 'they [the contractors] take the money, they take the chance'. The Global Head of Human Resources also called the contractors 'mercenary'. It was clear from onsite observation that new team members were rather hesitant and careful in expressing their own opinions in public and during the interviews. They preferred to provide their personal opinions, in particular about the two permanent staff (the team leader and the other experienced team member), during coffee and lunch breaks, when the two

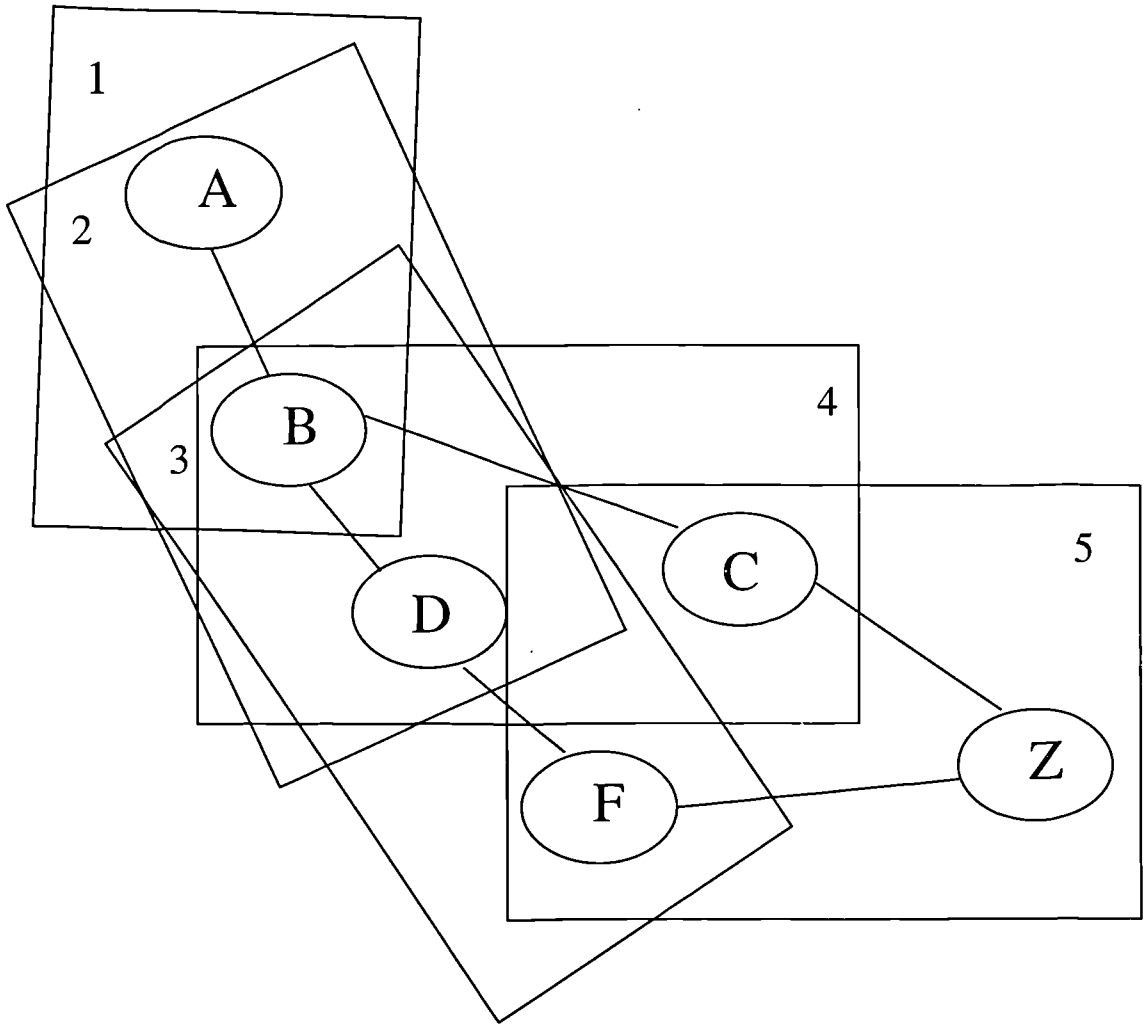
members were not around. Hence, the learning curve issue for the new members also concerned the problem of managing the group dynamics within the team.

5.3.5.1.2 Gaining Agreement on the Approach to Conduct IT System Testing

Very few problems arose during the early stage of implementation, when the GMP team tested each separate system (referred to by the team as '*stand alone*' testing). However, more serious difficulties arose when networked systems were tested. Figure 2 shows an example of how this testing was conducted by the GMP team. For instance, let us take the case of a system network that contains six systems: A, B, C, D, F and Z. System A feeds to system B. System B feeds to system C and system D; then system D feeds to F and to Z, as well as to system C, then to system Z. Instead of conducting end-to-end testing (from A to Z), the GMP team decided to conduct several '*near neighbour*' testing. This refers to the various boxes with numbers shown in Figure 5.2, e.g. between A and B, or between B, C and D.

The rationale behind adopting this testing approach, according to the team leader, was threefold. First, because of the number of IT systems in the organisation, end-to-end testing would have required an enormous amount of time and effort exceeding that available in the project. Secondly, from a technological viewpoint, end-to-end testing would not have been able to provide detailed information concerning the compliance of near-neighbour systems. Thirdly, there were practical difficulties involved in conducting such tests when IT systems were networked with external systems. In practice, however, many members of staff within the Technology Department, including some senior managers, were strongly against the approach taken by the GMP team.

Figure 5.2 An example of how networked IT systems were tested by the GMP team



This was reflected in a question asked by one senior manager: 'isn't it common sense to have an end-to-end test?' Even the GMP team members agreed that the combination of end-to-end and near-neighbour testing would certainly ensure the compliance of all IT systems, as most technologists would argue. The problem was that this approach would consume too much time and too many resources. This was why the team leader strongly insisted on having only near-neighbour testing. Eventually, this approach was accepted by all participants, but only after many intensive meetings. This indicates that the

introduction of a new testing approach was not at all easy, mainly because it challenged the existing norms of the community in question.

5.3.5.2 Overcoming Communication Barriers

Communication barriers were perceived by some of the interviewees to be an historical issue which could be traced back to the time of NatWest Markets, i.e. before NatWest GFM was formed. Such barriers could be found in each stage of the programme but were particularly significant during the implementation stage. They were not just a matter of physical distance; they were also a reflection of the 'mental distance' between different business units. As pointed out by several interviewees from Bishopsgate, communicating with Kings Cross House was often more problematic than communicating with New York or Singapore. Several explanations were given: '*they are two miles away*', '*they don't want to be communicated with*', '*there is no need to communicate*', and '*it is an extra effort*'. One interviewee further explained that:

> '*Not having a communication problem with New York but having a problem with Kings Cross House -- a lot of that is a mental approach on our part. We make a concerted effort to condense our communication with New York, because we know they have not been involved. But we often forget that Kings Cross House are sometimes as isolated as New York.*'

Communication barriers were found not only between Bishopsgate and Kings Cross House, but also between the various business units within Bishopsgate. As several

interviewees indicated, there was a communication problem between 'silos'. Both top-down and bottom-up communications were efficient and open; but problems occurred when organisational members needed to communicate across the departmental boundaries ('silos'). The existence of different silos was found to be closely linked to the subcultural differences between different business units, particularly between the front office (based in Bishopsgate) and the back office (based in King Cross House). One interviewee commented that: '*the front office has a fast moving culture, and the back office is much slower.*'

Two interviewees explained that one of the major strengths of the front office was its ability to develop new financial products rapidly as a means of coping with the fast environmental change in the investment banking industry. However, the key requirement for the back office was accuracy in settling payments in order to avoid potential penalties such as interest charges and fines. Therefore, the back office was less concerned with responding flexibly to environmental change. Moreover, one interviewee added that:

> '*The front office is very dominant in terms of its drive. They make the money, so everyone else is subservient to the front office. That is the predominant culture.*'

Other issues contributed to the subcultural differences between the two sites. In general, staff members in Kings Cross House had been working for NatWest Group for much longer than members in Bishopsgate. A high percentage of the workforce in Bishopsgate, including many contractors, was first employed when NatWest GFM was

formed in 1997. On the other hand, Kings Cross House was linked closely to the Group in terms of both geographic location and business functions. According to one of the interviewees from Kings Cross House:

> '*We have been working closely with the group (NatWest Group) for a while. We know why the rules are set, we know the expectation from the group, and we also know how things should be done in the way as it is.*'

By comparison, the organisational culture of Bishopsgate was more distinctive. As one interviewee explained:

> '*The Group culture is very bureaucratic. Kings Cross House is closer to that culture, but it is less so here (Bishopsgate).*'

Communication barriers became particularly significant during the implementation stage, when intensive communication between different business units was required. According to the team leader's past experience, the negative influence of communication barriers, particularly on the implementation process, was crucial. As the team leader observed:

> '*Individual managers who are three layers down have gone around the organisation and tried to implement the change because they were told by their boss to go and implement that change. The manager who went around trying to change something has been beaten, abused,*

demoralised by not getting the support of his peer group and his boss's peer group.[5]'

In order to minimise the impact of communication barriers on the implementation of GMP, tremendous efforts were devoted to ensure that team members faced as few obstacles as possible. It was found that two interrelated but distinctive approaches were often employed by the team. First, there was the exercise of legitimate power, mainly by the team leader. This was illustrated by the team leader:

'*We give them a label, because people remember labels more than remembering laws. We call them Keenan [the team leader's surname] laws... I told them "Don't pick a fight with the chaps down here. If you've got a problem with the law, come and see me and come and fight me. Don't fight these guys"... In terms of the lessons we learnt, I think probably this is the biggest one. There has always been a pressure coming down to get these things done properly... Fortunately, I am senior enough to enforce the change within my peer group and among the people below me. I have the support above me.*'

[5]. Peer groups here refer to people on a similar level but not in the same team.

Secondly, an effort was made to remove the communication barriers by influencing key individuals at the emotional level. This will be discussed in more detail in the next section.

5.3.5.3 Gaining Programme Priority

Because time was one of the scarcest resources within the organisation, inevitably people had to prioritise and select projects. Most of the interviewees complained that they had insufficient time to complete their entire workload and also cope with the increasing demands on them. '*Gaining priority is the only way to get any project done*', one interviewee commented. Faced with various sources of pressure, such as the strict requirements of regulatory parties, demands from the Boards, and business reputation concerns, upholding the programme's priority was not easy. The GMP team not only had to compete with other projects for organisational members' time, but were also required to maintain programme awareness by constantly communicating with their participants. Moreover, the programme limit of three years also created practical difficulties. As one team member pointed out, it was very hard to '*keep the momentum going*'.

Co-ordinating a large number of people after normal working hours and sometimes during the weekends, one team member explained, was a rather '*tortuous*' process. Testing during the implementation stage required sufficient time from the technologists and the end-users. In order not to disrupt the day-to-day operation in generating income for the organisation, most of the testing was conducted outside normal working hours. The difficulties were even greater when system testing involved overseas branches,

since this involved finding mutually convenient times for branches in different time zones. The time pressure became even greater when the GMP team needed to have company-wide business continuity practice drills. This required every member of staff to give up their weekends to travel to the office and participate in the drills. Understandably, therefore, the challenge faced by the GMP team was much greater than in the first two stages. However, it was not only the team who had to face problems related to the implementation of the GMP. Programme participants also found it difficult to provide extra time on top of their day-to-day jobs plus other projects running in parallel, even though they understood the importance of millennium compliance in relation to their work.

As already indicated, in order to sustain the programme's priority the GMP team had to find ways of influencing the programme participants at the emotional level. Despite the fact that programme participants were obliged to collaborate, this was not in itself sufficient. As one team member indicated:

> *'You can not just tell them "because Stephan Harris (CEO of NatWest GFM) wants you to do it, so you have to do it"... It is like asking them to do you a favour.'*

The emotional element related to gaining programme priority required the development of interpersonal relationship and trust between the team members and the participants. This is reflected in the finding that team members with well established personal networks in the organisation found it easier than less experienced members to get more

time and support from the participants. The approach to developing such relationships was explained by one of the team members:

> *'Do not expect that trust can be built up during your first contact. You have to let them believe that you are trying to help, not threaten them. When you talk to them the second and third time, they will be pretty open to you.'*

Despite the use of several techniques that helped the team members to gain some positive results, certain difficulties remained, particularly in developing interpersonal relationships and trust with overseas participants. In this respect, three issues were of particular significance. First, there had previously been little development of interpersonal networks with overseas participants. Secondly, physical distance and the problem of different time zones between branches created further difficulties. Thirdly, opportunities to visit overseas branches were limited mainly to the team leader and one other experienced team member. The result was that interpersonal relationships with overseas participants were difficult to develop. As the team leader explained:

> *'I think we are a new breed of team. In my working career right up to my early IT days as part of a three-man team, we worked in the same office -- we worked shifts. Two were on an overnight shift, and one was on an all-day shift. We very much felt a team. If one of us was sick, no problem: the other would work day and night whatever... A global team is completely different. I met everyone in the global team two or three times. I drank with them all,*

and I got drunk with them all. I am not saying that this is the way to build a team, but you only scrape the surface when you socialise with them. You only scrape on the surface of one line behind the individual. I guess the question is: what makes up the global team? -- because that is something I thought about. But it is definitely something different to the old concept of the other team.'

5.4 Emerging Themes from the Case

5.4.1 Introduction

The above discussion has provided a detailed account of how the GMP was organised and managed from its early preparation stage to its implementation. Several significant issues have emerged, in particular relating to the processes through which knowledge dispersed across functions was integrated. The following four key themes underlying the implementation of the GMP need to be highlighted: bridging the knowledge gap; overcoming communication barriers; sustaining programme priority; reconfiguring existing practice. Each of these will now be discussed in turn.

5.4.2 Bridging the Knowledge Gap

From the above discussion, it is clear that various types of knowledge gap can be identified. Within the GMP team, the learning curves faced by the newly recruited members point to a knowledge gap between the experienced and new team members. As indicated in the earlier discussion, it was manifest that such a gap existed not only in technical, but also in social, terms. In other words, new members were required to close

the knowledge gap through acquiring knowledge related to the programme and also by socialising with the experienced members and other programme participants.

In a broader programme context, the knowledge gap between the technologists and the end-users became visible during the process of building the IT system inventory. GMP team members' background knowledge in technology and business contributed greatly to closing this gap. Through continuous interaction with the technologist and end-users, team members were able to externalise what they knew, make sense of what they said, and codify lessons learnt from the interaction process.

5.4.3 Overcoming Communication Barriers

To close the various knowledge gaps in the programme, it was vital to overcome communication barriers which inhibited knowledge sharing amongst all participants. The research shows that such barriers were created not only by the physical distance between the organisational units, but also by subcultural differences between them. The distinctiveness of organisational subcultures was reflected in what people did as well as what people knew, as shown in the case of the differences between the front and back offices. In order to minimise the influence of communication barriers on the implementation of the cross-functional programme, an emphasis had to be placed on building interpersonal networks and trust with the programme participants.

5.4.4 Sustaining Programme Priority

To ensure the availability of resources required by the programme, it was essential to sustain programme priority. One of the major resources required by the GMP was

sufficient time from the participants for IT system testing and for business continuity practice drills. Despite the fact that all organisational members were obliged to participate in the programme, two further strategies had to be followed to sustain programme priority. First, it was essential to convey the concept and importance of Y2K compliance and business continuity to the participants. This was a matter of persuasion at the intellectual level. Secondly, the support of the participants had to be cultivated by developing interpersonal relationships and mutual trust. This involved influence at the emotional level.

5.4.5 Reconfiguring Existing Practice

The final theme emerging from this case concerns the way in which implementation of the GMP can be perceived as an ongoing process in which existing practice and beliefs were gradually reconfigured and modified. One of clearest examples was the use of documentation to codify all modifications made to the IT systems in the organisation. The research shows that documentation was not a common practice in NatWest GFM. This was because many organisational members did not consider documentation to be an effective means of adding value to the business, particularly in relation to the development and modification of IT systems. The building of the system inventory was not just a matter of establishing a centralised database. Symbolically, it also inspired a fundamental change in the practice of the IT community by injecting a new practice. The latter revealed how knowledge generated from IT system development and modification could be more effectively codified and shared.

A more detailed analytical account is provided in the following chapter. Chapter Six not only provides in-depth analysis of these emerging themes, but also synthesises findings generated from the two cases into a knowledge integration process theory.

Chapter Six: Analysis -- The Processes of Cross-functional Knowledge Integration

6.1. Introduction

Based on the procedure of open, axial and selective coding (Strauss and Corbin 1990), the data collected from the two research sites are analysed and presented in this chapter. From the analysis and given the objective of exploring the dynamics of knowledge integration within the cross-functional programme teams, four distinctive but interrelated processes are identified: boundary penetrating, priority maintaining, paradigm expanding, and organisational memory refining. This study acknowledges that the four processes identified here are not as definitive as they might seem. Different research findings may arise from similar social settings, when research foci and perspectives taken to anticipate the social reality can vary. However, the following analysis is based on the researcher's interpretation and knowledge which best conceptualises the dynamics of the studied phenomena.

The concept of boundary penetrating (Section 6.2) depicts not only how various types of boundary are created within different organisational contexts, but also the process through which programme participants penetrate these boundaries as a means of integrating knowledge cross-functionally. Evidence derived from the analysis indicates that the use of incentives, the selection of programme team members to create knowledge redundancy, and the influence of external forces -- as task-oriented factors -- all influence the process of boundary penetrating. In socio-emotional terms, the use of

social networks and the development of trust are also vital to the boundary penetrating process.

The second knowledge integration process identified by this study is priority maintaining (Section 6.3). This refers to the way in which programme team members ensure that the resources required by the programme are available by constantly competing with other programmes initiated in the organisation. Programme priority is maintained by achieving intellectual and emotional buy-ins. This in turn is greatly influenced by the progress of the programme and information sharing, and also by shared ownership of the programme and the reconfiguration of social networks.

The third process is paradigm expanding (Section 6.4). Through this process, the paradigmatic differences between communities, which reflect group diversity, are managed. There are similarities and differences between this process and two other concepts: collective sense-making (Boyce 1995) and collective mind (Weick and Roberts 1993). The evidence drawn from the analysis suggests that perspective taking (Boland and Tenkasi 1995) and mutual learning (March 1991) have a critical influence on the process of paradigm expanding.

The final process is organisational memory refining (Section 6.5). The term is used to indicate the way in which various forms of organisational memory (Walsh and Ungson 1991) are constantly re-examined, challenged, redefined and changed through the various stages of the programme. The management of group diversity is a critical source of creativity (Hauser 1998; Wheelwright and Clark 1992) and has a major impact on the

process of organisational memory refining. In addition, the transformation of information into knowledge, and the application of knowledge in practice are also vital to this process.

Even though the four knowledge integration processes are analytically separate, they are in fact highly interconnected. The dynamic interrelationships between the four processes are highlighted in Section 6.6. Then Section 6.7 summarises the chapter from the perspectives of organisational memory and the concept of knowing (Blackler 1995).

6.2 The Process of Boundary Penetrating

The term 'boundary penetrating' is used to refer to the process by which team members break through various task and socio-emotional boundaries (Benne and Sheats 1948) to acquire the information and knowledge needed for the programme. The following discussion highlights three interconnected types of boundary: those created by the dispersion of organisational units, the reality of different organisational subcultures, and the existence of functionally specific knowledge. Although separated for analytical purposes, these three types of boundary are closely related to each other. The discussion highlights the processes used in the two cases to penetrate each of the boundaries.

6.2.1 The multi-faceted and multi-directional nature of the boundary penetrating process

Table 6.1 summarises the complexity of the three types of boundary. As already stressed, the three types are closely interrelated: the physical dispersion of organisational units triggers the development of different organisational subcultures within each unit as

well as the construction of functionally specific knowledge. The evolution of organisational subcultures further inhibits knowledge sharing across different organisational units.

Table 6.1 Various types of programme related boundary

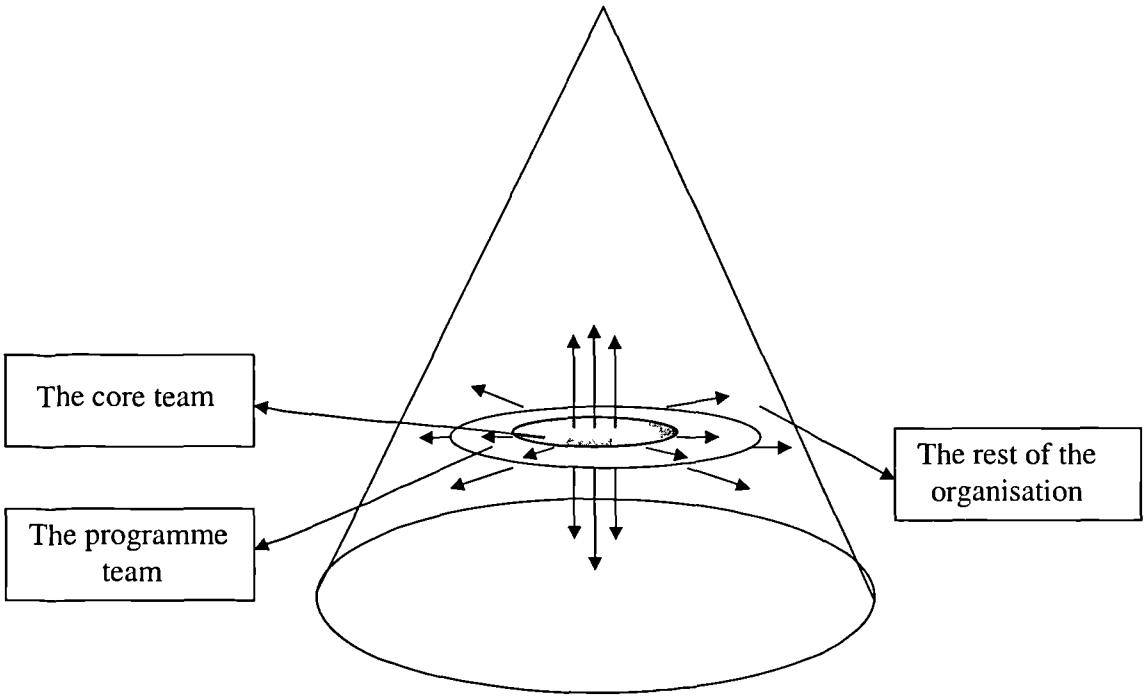
	Physical dispersion of organisational units	Different organisational subcultures	Functionally specific knowledge
Core-team level (task-related aspect)	The physical dispersion of team members creates a boundary that limits collaboration, which is vital to achieve the overall goal	Subcultural differences between team members act as a boundary which is reflected in the approach through which work is accomplished	The different knowledge required to accomplish the tasks creates a boundary to building a shared understanding between team members
Core-team level (socio-emotional aspect)	Physical distance creates boundaries which limit the opportunity for face-to-face social interaction	Different subcultures brought in by the team members create boundaries which inhibit the building of social relationships	The different knowledge backgrounds of team members create boundaries to developing competence and commitment trust
Programme-team level (task-related aspect)	The physical dispersion of programme participants creates boundaries which make collaboration harder and influence the implementation of cross-functional programmes	Different subcultures brought in by the programme participants create conflicts and influence the way in which the importance of the programme is perceived	The different knowledge possessed by the participants, resulting in little knowledge redundancy, creates boundaries which prohibit programme implementation
Programme-team level (socio-emotional aspect)	The physical dispersion of programme team members creates difficulties for developing and sustaining a 'community of practice'	Subcultural differences cause conflicts between participants and create boundaries to enhance group coherence	The different knowledge possessed by the participants create boundaries to developing mutual understanding and competence trust
Organisational level (task-related aspect)	The physical dispersion of organisational units influences the rest of the organisation in allocating the resources required by the programme	Subcultural differences between the programme team and the rest of the organisation create boundaries which can inhibit the implementation of the programme across the organisation	The knowledge differences between the programme team and the rest of the organisation inhibit the cross-functional knowledge sharing vital for implementation
Organisational level (socio-emotional aspect)	The physical dispersion of organisational units influences the social interaction between the programme team and the rest of the organisation, and that can create boundaries for the programme team in gaining supports at the organisational level	Subcultural differences between the programme team and the rest of the organisation create boundaries which limit the social interactions between different 'communities of practice'	The knowledge differences between the programme team and the rest of the organisation create boundaries which prohibit the building of companionship, competence, commitment and trust

Table 6.1 also shows that the boundaries are observed at three different levels: the core team, the programme team, and the organisation. The core team refers to the programme members who participate in the programme on a full-time basis. The programme team includes the core team as well as programme participants who are involved in various parts of the programme on a part-time or voluntary basis.

Within each context, the task-related and social-emotional aspects are highlighted. Clearly, different boundaries exist not only within the core team itself but also within the programme team, where boundaries lie between the core team and the programme participants, as well as among the programme participants. Additionally, different boundaries can be found at the broader organisational level. Here boundaries are created between those members who are involved in the programme and those who are not. In addition to being multi-faceted, the boundary penetrating process is also revealed, in the two cases, to be multi-directional in the sense that boundaries have to be penetrated vertically, horizontally and laterally (see Figure 6.1).

First of all, the boundaries need to be penetrated horizontally within and between the core team, the programme team and the rest of the organisation. Secondly, top-down penetration is observed in the two cases as there is a need to gain the involvement and commitment of employees in lower positions in the organisational hierarchy. Finally, the bottom-up approach is used to penetrate various boundaries which exist between the programme team and the top management. The importance of using a bottom-up approach to penetrate such boundaries will be illustrated in the discussion of the priority maintaining process (Section 6.3).

Figure 6.1 The multi-directional nature of the boundary penetrating process



6.2.2 Barriers created by the physical dispersion of organisational units

Both case companies have head offices in the UK and other offices dispersed around the world[6]. For projects with organisation-wide coverage, such as BRP and GMP, it is understandable that the physical distance between various sites is a vitally important issue that has to be considered by the two cross-functional project teams. Furthermore, this issue influences not only the project team itself, but also other organisational members who are involved in the project on either a full- or part-time basis. As indicated earlier, both teams have core team members, based mainly in their head offices, and a small number of members located elsewhere. Numerous part-time team members and

[6] Although both companies have global operations, BTC's business activities are concentrated mainly in the UK and the Irish Republic.

other programme participants are spread over various regions. The dispersion of project participants inspired the two case companies to adopt a combination of conventional teamwork with virtual ICT-supported teamwork. Based on the dispersion of team members and project participants, or the degree of virtuality, the concept of teamwork can be represented as a continuum with the conventional team at the one end (members are located physically in one place) and the virtual team at the other (all members are geographically dispersed). In this respect the two teams differ, with the BPR team closer to the conventional end and the GMP team closer to the virtual end. Virtual teams, in order to overcome the restraints of geographical dispersion, can use ICTs such as groupware and Intranets (Ciborra and Suetens 1996; Greengard 1994; Jarvenpaa, Knoll and Leidner 1998). By using virtual teams organisations are able to draw on people who are equipped with the required skills and experience but who are dispersed across the globe (Lipnack and Stamps 1997). Furthermore, Greiner and Metes (1995) point to the advantage of using virtual teamwork from a cost-saving point of view, because the amount of travelling costs can be cut down. However, virtual teamwork can also be problematic and does not solve all problems.

The research findings suggest that the geographical dispersion of organisational units influenced both case companies in two distinctive but interrelated ways. First, in relation to the formal departmental structure, the dispersion had encouraged the various subunits to develop their own ways of working and distinctive subcultures in addition to their own departmental orientations. This is because physical distance inhibits face-to-face interaction and the building of social relationships (Jarvenpaa, Knoll and Leidner 1998; Lipnack and Stamps 1997). Yet these social relationships are essential to the

development of shared practices (Lave and Wenger 1991; Orr 1990) and cultures (Smircich 1983). This mirrors the suggestion from Handy (1995) that it is difficult to develop trust within virtual organisations. It is also related to the problems of isolation felt by the dispersed members, as identified by Nohria and Eccles (1992). This problem was recognised by interviewees in both cases when they talked about the existence of organisational silos. Barriers that hamper cross-functional communication and knowledge sharing are evident as one of the byproducts of the evolution of silos. In particular, when business units are several hundred or even thousands of miles apart, there is enormous difficulty in narrowing the silo gap. There is no direct evidence to suggest that these boundaries are created purely by physical distance, but undoubtedly the latter intensifies the social isolation of the different units.

Secondly, the geographical dispersion of organisational units is seen to influence informal organisational relationships, particularly in terms of the development of a 'community of practice' (Brown and Duguid 1991). According to this concept, a programme team as a whole can be considered as a community since the individuals are all involved in joint activities. Each community has members who are working on the project on a full-time basis, such as the core members of both project teams, as well as members from various business units who are involved on a part-time basis. It must be stressed that a cross-functional project team is not necessarily the same as a 'community of practice'. However, by taking into account the full- and part-time programme participants, it is clear that the informal interaction between team members and the participants and the collective activities performed by all members involved in the project do overlap with the 'community of practice' concept. Evidence from both cases

indicates that interpersonal relationships develop through social interaction, and this serves as one of the main sources to glue community members together. Dispersed members who are less involved are gradually left out of the main body of the community, particularly where they are engaged in full-time work, and so have very little spare time for social interaction. These dispersed members contact and interact with other members only to share information and knowledge.

Physical distance has an influence not only at the programme team level, but also at the core team level. The empirical study by Warkentin, Sayeed and Hightower (1997) suggests that despite the fact that virtual teams and conventional face-to-face teams demonstrated similar levels of communicative effectiveness, face-to-face team members reported a higher level of satisfaction because interpersonal links were established. As observed in both the case-study companies, those less involved come to be marginalised if a substantial amount of face-to-face interaction cannot be maintained. In practice, however, the opportunity to engage in face-to-face interaction is enjoyed by only a very small number of members. This is partly because of the travelling cost involved, and partly because the importance of informal social interaction was not fully recognised by either organisation. This confirms the point made by Newell and Swan (2000): that informal social co-ordination mechanisms tend to be under-emphasised in the development of trust relations. This is partly because it is seen as time-consuming and troublesome to ensure that dispersed members are continuously informed and communicated with, particularly when members are in different time zones. Even though the availability of e-mail has facilitated the dissemination of task-oriented data

and information, to ensure that knowledge is actually shared within the programme team is not easy (Ciborra and Patriotta 1996), particularly when the knowledge is difficult to externalise and codify (as is the case with tacit knowledge): programme participants often face difficulties in sharing such knowledge with other dispersed members (Pan and Scarbrough 1999). Hence, in both programme teams a high percentage of dispersed members are only loosely attached to the community at the socio-emotional level even though they have constant access to task-related information. Communication between the core and the dispersed part of the community tends to take place between individuals rather than at the team or group level. This further influences the way in which subcultures develop within the community.

6.2.3 Observed mechanisms for boundary penetrating

The two teams studied here sought to penetrate the formal and informal boundaries in rather different ways. In the GFM case, various methods were employed, including travelling and using ICTs, mainly telephone and e-mail. However, one of the most efficient approaches to communicating and sharing knowledge across the globe in this company was the use of standardised procedures and formats to record information and knowledge formulated during the planning stage and enforced prior to and during the implementation stage. Despite the evident limitation of codification (see, for example, Blackler 1995; Hansen et al 1999; Hedlund 1994), this approach appeared to be necessary and appropriate given the nature of the GMP. As indicated earlier, one of the major tasks was to provide regulatory bodies with documented proof that systems were Y2K compliant. Hence, documentation was compulsory. The rationale behind adopting a standardised documentation approach, rather than allowing deviation between

branches, was to ensure that programme participants all over the world were doing the same thing and referring to the same thing in their discussions. The GMP team gathered all information and knowledge documented by the branches and distributed it to the various branches according to the specific needs of the branches. This process enabled the core team, mainly the team leader, to monitor each branch's progress separately and to avoid communication problems between the different silos.

The approach taken by BTC was more radical. As a result of the D90 Programme, which located all head office functions in one building, the problem of the dispersion of organisational units had been partly solved. The remaining need was to ensure that physical distance would not create further barriers between the head office and the regions. In addition to intensive travelling between the regions and the head office, project participants based in the head office were required to work temporarily in different stores in order to understand the problems faced by the regions. Furthermore, another initiative related to the BPR programme was the advancement of an IT network between the head office and the regions, facilitating enhanced knowledge sharing. This project was still in the planning stage during the data collection process. Hence, there was no direct insight to illustrate the influence of the IT network on cross-functional knowledge sharing. However, an empirical study by Ciborra and Patriotta (1996) indicates that the use of groupware does not necessarily encourage knowledge sharing across product development teams in a virtual setting. The research findings also suggest that the change of the appraisal and reward system, and the delegation of authority to the regions also significantly contributed to knowledge sharing between these two sites.

6.2.4 Subcultural boundaries and their penetration

As explained in the previous section, it is evident in both cases that the dispersion of organisational units directly encouraged the development of distinctive organisational subcultures; and that, furthermore, subcultural differences were reflected in the distinctiveness of functional-specific knowledge. In other words, this type of knowledge is collectively constructed by a group of people with similar subcultural backgrounds. Similar empirical findings can be observed in Sackmann's (1991) study of different types of cultural knowledge, particularly recipe and axiomatic knowledge. This type of knowledge is similar to what Collins (1993) and Blackler (1995) call encultured knowledge. The research findings suggest that an organisational subculture can easily become a boundary separating people who participate in the knowledge-construction process from those who do not. The implication for cross-functional knowledge integration is that an organisational subculture creates a barrier that restricts communication and knowledge sharing. It is manifest in both cases that the difficulties created by subcultural differences are not related only to the willingness of members of staff to share what they know with others; just as important is the issue of whether a shared understanding can be achieved among members of staff from different subcultural backgrounds. Knowledge constructed within a certain subcultural group is often context- dependent (Nonaka and Konno 1998), and this limits the extent to which people from different subcultural backgrounds can understand it.

Two critical lessons emerge from the analysis of the two cases in relation to the problem of having a specific subculture 'embrained' in each project participant. First, the different subcultures brought in by different programme participants created boundaries

which inhibited knowledge integration as well as social interactions amongst the participants. The steep learning curve faced by the new members was not just a matter of acquiring new knowledge (Huber 1991), but was also about the issue of understanding the different subcultures of other participants. In other words, in order to penetrate such subcultural boundaries, it is necessary to socialise with other project participants. This is related to the concept of situated learning, as proposed by Lave and Wenger (1991). This suggests that through participation, observation and social interaction, learners with various experiences blend together to create a coherent learning community. However, the situated learning concept does not provide a clear explanation of the situation in which all learners are new to the learning community and have distinctive subcultural backgrounds. For instance, the two cross-functional programme teams were composed of participants from various organisational units who had little experience of the nature of the programme. Instead of blending into an existing subculture of the learning community, as the situated learning concepts suggests, a new subculture that was unique to the cross-functional programme emerged and evolved through the socialisation and collaboration between programme participants. Additionally, learning curves indicate not only the need to acquire new knowledge and discard obsolete knowledge, but also the need to discard contradictory beliefs and values. Hedberg (1982) similarly highlights the difficulties involved in *unlearning*. The concept of the *stickiness* of information, as suggested by Von Hippel (1994), matches the present study's view of organisational subculture as *sticky*, and the uniqueness of programme subculture is reflected in members' social identity (Tajfel and Turner 1985) as part of the cross-functional programme.

Secondly, the fact that different organisational subcultures are embrained in different project participants suggests that issues of knowledge integration within the cross-functional programme team context often revolve around the problem of understanding organisational subcultures. Empirical findings provided by Lam (1997) also confirm that cultural difference represents not only the difference in people's mentality, but also the way in which knowledge is constructed and organised. Such differences complicate knowledge sharing across cultural boundaries and hinder the building of a shared understanding between different cultural groups. The evidence from this study suggests that the phenomenon studied by Lam (1997) is not unique to national cultural groups, but is applicable to different subcultural groups within the same organisation. At the same time, the influence of subcultural differences on the way in which knowledge is applied is also extremely important. In other words, these differences are reflected in what people do as well as what people know. For instance, in the GFM case, the front office's main activity was to trade financial products for clients. Its subculture, in terms of what they did, was fast moving and risk-taking in comparison with the back office's slow moving and risk-free subculture. Such subcultural differences were often reflected in mutual criticisms between the two offices, and created a boundary that prevented the building of a shared understanding between the two.

In terms of penetrating the subcultural boundary, the actions taken by both teams combined top-down, bottom-up and horizontal approaches. The three approaches can be differentiated according to the positions of organisational members who penetrated the boundary and who were penetrated in the organisational hierarchy. In the BTC case, techniques such as learning events and brainstorming sessions were used. These can be

considered as a combination of horizontal and bottom-up approaches, because project participants were either on the same level as the BPR team members or one or two levels above in terms of their positions. These events created an environment in which different opinions and beliefs could be shared and social interaction between participants could take place. More importantly, this served as a social context in which the subcultural boundary could be penetrated by building a shared understanding not only about the subject of BPR but also about the different subcultural backgrounds 'embrained' in the participants. However, incremental approaches did not always work as expected by the project team. Two crisis meetings, classified here as a top-down approach, were called as a means of achieving consensus by engaging top management. Although these top-down forces immediately helped the project team to overcome the barrier, fundamental problems remained, as became clear in later stages of the programme. This phenomenon reflects the stickiness of organisational subculture as well as the psychosocial defences created through the interaction between different subcultures (Allcorn 1995). Evidence from the BTC case suggests that it is questionable whether a shared understanding, or shared mental model in Senge's (1990) terms, can be built out of various subcultural groups by using a top-down approach without the development of dialogue (Schein 1993) or collective sense-making (Boyce 1995).

In the GFM case, a top-down approach was used more often but also more selectively, particularly in the early stages of the programme. In order to gain ample recognition and build programme authority, a top-down approach was constantly exercised in order to increase awareness of the Y2K problem and gain the CEO's approval that the project team's work was important. However, it was selective in that it targeted members of

staff below the director level. At the director level, i.e. among the peer group of the team leader, interpersonal relationships and previous collaboration experience were observed as the main influence in penetrating the subcultural boundary and gaining support. Hence, this can be regarded as a horizontal approach. Through the team leader opening the door of each silo, project team members faced fewer problems than the BPR team, even though they had relatively less time to develop social relationships with the project participants. This case shows that a top-down approach can be beneficial, whereas in the BTC case it was harmful. However, it requires selectivity in terms of targets. It is also much more effective to use this method in the early stage when seeking to penetrate the subcultural boundary, rather than waiting for problems to appear.

6.2.5 The boundary of knowledge and its penetration

In addition to the boundary related to organisational subcultures, evidence abstracted from both cases suggests that knowledge sharing and knowledge creation in cross-functional projects are inhibited by the nature of knowledge, how it is constructed, and where it is embeddeds. Although Hutt, Walker and Frankwick (1995) propose the concept of 'interpretive barriers' to refer to the difficulties created by participants' different knowledge backgrounds when making strategic decisions, they do not provide a clear explanation of how the nature of knowledge influences the creation of barriers. Knowledge such as space management, in the BTC case, and system modification, in the GFM case, is often functionally specific and constructed through the process of trial and error, or learning by doing (Pavitt 1991). This is what Polanyi (1958) terms tacit knowledge, what Cohen and Bacdayan (1994) call '*procedural knowledge*', and what Sanchez and Heene (1997) call '*know-how*' and '*know-why*'. It is evident that this type

of knowledge creates a barrier which blocks other members of staff from understanding the meaning underlying such knowledge. For example, the Macro Space project participants encountered difficulties in learning the concept of space management, and the GMP team members could not easily understand why each system for a specific financial product was modified in a particular way. Similarly, Nonaka and Takeuchi (1995) argued that, due to the tacit nature of procedural knowledge, know-how and know-why, it is relatively difficult to externalise and codify these types of knowledge. It was observed in the two cases that the difficulty of articulating such knowledge further hindered knowledge sharing across functions. Furthermore, the boundary of knowledge can be explained by the concept of knowledge redundancy (Nonaka 1994): a degree of knowledge redundancy between the programme participants not only provides a foundation to build a shared understanding amongst them, but also helps the participants to acquire new knowledge. Hence, as found in the two cases, a low degree, or the complete absence, of knowledge redundancy between the participants can create boundaries which inhibit cross-functional knowledge sharing. The tacitness and social embeddedness of knowledge also create a boundary which separates people who are involved in constructing the knowledge from those who are not. This phenomenon is similar to what Matusik and Hill (1998) describe as '*permeable organisational boundaries*'. According to their study, private knowledge is socially constructed and embedded, and is bounded within a specific context surrounded by the permeable organisational boundary. This boundary, created by the tacit nature of private knowledge, prevents people external to the specific social context from knowing, understanding and imitating it.

In addition to the barriers related to tacit knowledge, those related to explicit knowledge are also evident in both cases. Despite the fact that explicit knowledge is often codified in written forms such as documents or databases, its accessibility can be problematic. In the BTC case, the database created by each business function was often regarded as confidential and accessible only to certain members of staff. Also, the limited and selective accessibility of explicit knowledge was found in the GFM case, particularly when it related to confidential issues such as trading and client details. In addition, the understanding of explicit knowledge can also be problematic. For instance, in the GFM case traders found it difficult to read codified technological knowledge even though they were jointly involved in modifying the systems with the technologists. Hence, it is clear that explicit knowledge can also be functionally specific and context dependent. The barrier of explicit knowledge lies in its accessibility and the ability to absorb and understand such knowledge. As the discussion of knowledge typologies in the literature review revealed, some writers overemphasise the importance of tacit knowledge and underestimate the difficulties related to explicit knowledge (e.g. Athanassiou and Nigh 1999; Birchall and Tovstiga 1999). They thus run the risk of not acknowledging that explicit knowledge, like tacit knowledge, can create boundaries, although of a different kind from those of the latter.

In order to acquire the knowledge required by the project, both programme teams were observed to constantly attempt to penetrate the barriers created by these different types of knowledge. However, they used different methods. In the BTC case, the most commonly employed approach was to get people with such knowledge involved in the programme as part of the project team. For Blackler (1995), this is one approach to

utilising and managing embrained knowledge. During the BTC planning stage, project team members were continuously negotiating with various business functions, trying to persuade them to participate in the BPR programme. This meant that they had to negotiate with functional heads to release these representatives. In other words, they needed to penetrate the departmental barrier before they could invite potential participants.

Even after getting representatives together from different departments, team members still needed to overcome the subcultural barriers inherited by each representative. The penetration of the knowledge barrier varied across the different parts of the BPR programme, as well as being dependent on the expertise of project participants. For instance, in the Sales Plan project, representatives from Marketing, Beauty, Healthcare and Leisure business units were involved in similar work and therefore had a substantial shared understanding of the concept of sales promotion. Thus, the knowledge barrier here was less significant than that of other projects such as Macro Space. The project participants had overlapping expertise, which is what Nonaka (1994) terms '*knowledge redundancy*' and what Demsetz (1991) labels '*common knowledge*'. However, in the Macro Space project the knowledge barrier was much more evident, because the concept of space management was less widely understood by participants from other departments. In other words, there was very little knowledge redundancy amongst the project participants.

In the GFM case, the knowledge boundary and the approach taken to boundary penetrating were different. In addition to the difficulty of finding sufficient time in the

end user's tight schedule, the major barrier derived from the way in which knowledge was constructed. As indicated earlier, the main task of the GMP members was to acquire the knowledge created during the modification of IT systems. Since this modification involved the collective contributions of end users and technologists, and was not fully recorded, the major challenge faced by the team members was to articulate this knowledge from the two groups concerned. However, the end users only had the business aspect of knowledge concerning why systems needed to be modified in certain ways; while the technologists knew about the technological method by which systems had been modified. With a relatively low degree of knowledge redundancy between these two groups, team members were required to act as a bridge to close the knowledge gap. In addition to communication skills, it was clear that team members' experience and background played a vital role in articulating such knowledge. Hence, it is understandable why team members had to have some business knowledge in addition to their technological background. Furthermore, the standardised procedure for codifying knowledge, as discussed earlier, served as a vehicle for overcoming some of the knowledge barriers, particularly in the content of global knowledge sharing.

6.2.6 Issues influencing the boundary penetrating process

From the above discussion, it is clear that boundary penetrating is multi-faceted as a consequence of the dispersion of organisational units, the existence of organisational subcultures, and the nature of knowledge. Accordingly, boundary penetrating is a multi-dimensional process containing top-down, bottom-up and horizontal approaches. Based on Benne and Sheats' (1948) study of the individual's role in the group, the main factors

influencing the penetration process may be categorised into task-related and socio-emotional aspects.

6.2.6.1 The task-related aspect

The study suggests that three particularly influential and interrelated mechanisms are helpful in penetrating various boundaries elaborated above: the use of incentives, the selection of project team members, and the influence of internal and external forces.

6.2.6.1.1 The use of incentives

In both cases, incentives of various forms helped project team members to achieve boundary penetrating, especially where a boundary was created by the dispersion of organisational units. For instance, in the BTC case, the adoption of a new reward system was recognised as a strong incentive which encouraged members of staff to participate in the BPR programme. This is also evident in the study by Larsson, Eneroth and Konig (1996), who argue that reward systems can help organisations to overcome employees' resistance to radical change. Similar evidence is provided by Agarwal and Singh (1998), who indicate that the effectiveness of an organisational change strategy lies in its congruence with the modification of reward systems.

Additionally, both project teams relied on other business units to contribute resources and expertise. Therefore, it was vital to influence those staff members who controlled such resources. This observation can be related to the resource dependency theory proposed by Pfeffer and Salancik (1978), who argue that management's decisions are strongly influenced by the agents who have control of vital resources. Resource

dependency theory is helpful in exploring how boundary penetrating operates as a process of acquiring critical resources. However, evidence from the two cases suggests that resource dependency theory fails to explain how the resource itself can often create another type of boundary, as is illustrated by the context-dependent nature of functionally specific knowledge. In other words, knowledge which is socially constructed by various departments often prevents the project team members from understanding it, because these members were not involved in the original knowledge-construction process. Therefore, even when the project team could gain access to the resource in question, the utilisation of that resource presented another boundary that the project team had to penetrate.

It was observed in the two cases that two major issues influenced and motivated the gatekeepers of vital resources to allow project team members to gain access to the necessary resources. First, the possibility of exchanging resources encouraged cross-functional knowledge sharing and collaboration (Grandori and Soda 1995). For example, by engaging in the BPR or GMP programmes, participants were able to demonstrate their concerns and interests. Thus, to get involved in the programme was to understand other participants' intentions as a means of creating opportunities to gain more resources. Secondly, some interviewees stated that one of the motivations for getting involved in the programme was to ensure that other departments would not obtain excessive resources. This was particularly apparent in the BTC case with the issue of store space. Each business unit wanted to ensure that the store space was divided fairly and that profit was measured in a way that was not contrary to their interests.

6.2.6.1.2 The selection of team members to ensure knowledge redundancy

The selection of project team members plays a vital role in the boundary penetrating process, particularly in terms of their knowledge and experience. In addition to knowledge, such as that of project management, interpersonal and communicational skills are also crucial. Knowledge redundancy (Nonaka 1994) among project team members and the project participants is of paramount importance. Each of the two cases followed its own distinctive approach to knowledge redundancy. In the BTC case, team members were selected from various business units for specific parts of the BPR programme. Before joining the team, members already had some business knowledge, which they needed to integrate with other project participants. However, business process knowledge was limited to the BPR team, and there was no redundancy between the team members and the project participants before the programme commenced. Knowledge redundancy was gradually developed through various stages of the programme. An external consultancy team was brought in prior to the BPR programme to investigate existing business processes, to identify new opportunities and to disseminate the knowledge of how to manage a BPR programme. The interviewees recalled that there were limited opportunities for the BPR team to learn from the external consultants. Evidence suggests that this was partly because the time scale did not allow[7], and partly because there was very little knowledge redundancy between the BPR team and the external consultancy team. In the GFM case, the selection of GMP members relied on recruiting people externally. To ensure knowledge redundancy, candidates

[7] As described in the BTC case study, the BPR team was formed a few weeks before the external consultancy team left the company.

were favoured if they had both technological and business knowledge, as well as experience in millennium-compliance programmes.

From the above discussion, it is clear that in the GFM case there was already knowledge redundancy, but this had to be created in the BTC case, particularly in terms of the knowledge and implementation of BPR. In both cases, a degree of knowledge redundancy was able to ease the implementation of the programmes and benefit the knowledge integration processes. Such redundancy can be developed through the selection of programme participants or be nurtured as the programme progresses. Furthermore, the two case companies both recognised the importance of having knowledge redundancy and tried to create such redundancy prior to the programme initiatives. This was more problematic in the BTC case than in the GFM case. This was due in part to the limited learning taking place between the BPR team and the external consultancy team. Also, the time spent on creating such redundancy, or overcoming the boundary created by low knowledge redundancy, slowed down the progress of the programme. Hence, the importance of knowledge redundancy lies in not only the building of a shared understanding, as Nonaka (1994) suggests, but also in its influence on the implementation of cross-functional programmes.

6.2.6.1.3 External forces

Another issue identified by this study is the influence of external forces. As indicated earlier in the GFM case chapter, the GMP was compulsory and regulated by the Bank of England and IMRO. External forces were thus vitally important in triggering the GMP, and they further influenced the top management's decision to ensure the compliance of

information systems within GFM. Again, from the perspective of resource dependence theory, it is clear that external forces can exert pressure on an organisation in terms of shaping its resource allocation (Barringer and Milkovich 1998; Pfeffer 1981; Pfeffer and Salancick 1978). Similarly, findings from the BTC case suggest that external forces such as market competition and the slow growth of sales turnover persuaded the top management to implement a radical change of business processes; and this in turn helped project team members to penetrate departmental boundaries. However, in this case different organisational members perceived and interpreted the external environment in different ways. This partly explains the resistance to the change initiatives, particularly by some of the senior managers. And it also clarifies why internal forces such as the intervention of the top management were enhanced by external forces in penetrating departmental boundaries.

6.2.6.2 The socio-emotional aspect

In addition to the formal aspect, two socio-emotional mechanisms influenced the boundary penetrating process: social networking and trust. From the above discussion, it is clear that formal issues are beneficial primarily in helping to penetrate departmental boundaries and part of the knowledge boundary. By contrast, the socio-emotional mechanisms are related to all three types of boundary, particularly the subcultural boundary.

6.2.6.2.1 Social networks

In both cases, social networks, or 'network ties' in the terminology of Nahapiet and Ghoshal (1998), played a vital role in penetrating all three types of boundaries. The

development of a social network was especially marked among those members of staff who had extensive working experience within the organisation. Thus, experienced team members were able to penetrate the knowledge boundary by knowing who had the knowledge, and were able to penetrate the departmental boundary by gaining support through their social networks. This reinforces the view of Coleman (1988) that organisational members can often gain access to vital information through their social networks.

In both cases, also, experienced team members were able to penetrate the knowledge boundary by working for and with different functions. This is because their experience and understanding of how different business units worked helped them to appreciate how boundaries could be penetrated. For instance, they 'knew' whom they should speak to and when to speak to certain members of staff. This confirms the benefits of social networks identified by Burt (1992): accessibility, timing and referrals. Furthermore, the importance of social networks is not limited to the exchange and combination of knowledge -- which are identified as the process of knowledge creation (Nahapiet and Ghoshal 1998). It is also critical to the penetration of various boundaries, and that is vital to the integration of knowledge within the cross-functional project team context.

6.2.6.2.2 Trust

The second issue identified in the two cases is trust. The influence of trust in relation to the boundary penetrating process is multi-dimensional. First of all, in terms of penetrating the departmental boundary, trust is critical in ensuring that project participants do not feel threatened by sharing their knowledge with the project team

members. This echoes the observation of Misztal (1996) that trust is a willingness to be vulnerable to another party; or, as Ring and Van De Ven (1994) put it, trust is the belief in another's good intentions and concern. This type of trust is described by Newell and Swan (2000) as 'companion trust', which is seen as identification- and process-based. Secondly, trust denotes a belief in people's capability (Szulanski 1996), or what Newell and Swan (2000) call 'competence trust', which is a belief in competence. This is essentially knowledge- and characteristic-based. For instance, in the BTC case the organisational members' participation in the BPR programme was a demonstration of the belief in the project team's ability to deliver the new business processes. Trust here facilitated the penetration of the subcultural boundary, particularly in opening up others to the new culture proposed by the BPR approach.

Thirdly, the influence of trust is also evident in the penetration of the knowledge boundary. Particularly in terms of gaining access to functionally specific knowledge, trust helped project team members to overcome the departmental and subcultural barriers, and this further helped team members to acquire the necessary knowledge. Similar arguments are made by Ouchi (1981), who sees trust as a belief which reflects people's openness, and by Newell and Swan (2000), in their concept of companion trust, which is process-based. However, this type of trust is limited primarily to the accessibility of knowledge. This study suggests that the sharing of tacit and socially embedded knowledge demands a different expression of trust to that involved in the issue of accessibility. Thus, in the GFM case, the articulation of tacit knowledge required trust-building between the team members, the end users and the technologists. The trust required here was not merely the openness which facilitated the interaction

between these three groups of people. More importantly, it was the end users' and the technologists' belief in the project team members' capability to externalise tacit knowledge. Referring again to the importance of social networks, it is clear that the development of the trust required in externalising socially embedded knowledge was influenced greatly by team members' social networks as well as their experience of the organisation.

6.2.7 Summary of the boundary penetrating process

As we have seen, the boundary penetrating process is multi-faceted and multi-directional. Thus, the process aims to penetrate not only the boundaries created by the physical dispersion of organisational units, but also those resulting from the existence of different organisational subcultures and functionally specific knowledge. The importance of boundary penetrating is reflected in the notion of 'solving the boundary paradox' (Quintas, *et al.* 1997) by which organisational members are able to exchange and combine knowledge (Nahapiet and Ghoshal 1998). Table 6.1 summarises various types of boundary which were faced by the two cross-functional project teams and conceptualised based on the interplay between different issues and organisational contexts. Obviously, each type of boundary did not exist in isolation; rather, all the boundaries reinforced one another. The distinction between task-oriented and socio-emotional mechanisms, as discussed above, indicates that boundaries could be penetrated not only by the use of incentives, the selection of team members, and the influence of external forces. In addition, the use of social networks and the development of trust were found to be equally important. What must be stressed is that the penetration of various boundaries does not necessarily mean that knowledge can be integrated cross-

functionally and continuously. The three other knowledge integration processes also play key roles.

6.3 The Process of Priority Maintaining

The term 'priority maintenance' refers to the process by which project awareness is constantly reinforced and priority is continuously sustained through competition with other projects and initiatives. The following discussion illustrates two aspects of priority maintenance: project management and social capital. Within the discussion of each aspect, the actions taken by the two project teams are elaborated and compared with accounts in the current literature. Finally, factors which influence the priority-maintenance process are identified and explained.

6.3.1 The importance of priority maintaining

From the two cases, it is clear that the number of projects initiated and the amount of resources available within each organisation demonstrated a lack of balance. In other words, not every project idea which was raised was able to obtain resources and proceed to implementation. Hence, initially project teams not only competed with other projects for resources, but also needed to ensure that the resources required by the project were available throughout the project life cycle. In the BTC case, initiative overload occurred during various stages of the project. This appeared to be linked to two issues. First, there was the difficulty of sustaining the awareness of the top management and also those members of staff who would eventually become the end users of the programme. This was difficult because of the large number of projects running in the organisation.

Secondly, there was a need to keep the programme alive by competing with other projects and by ensuring that the resources required for implementation were made available. In the GFM case, the key to maintaining programme priority was to obtain sufficient time from the end users and the technologists to codify the system modifications and to test their compliance, and to encourage all organisational members to participate in business continuity practice drills. Despite the fact that the GMP was compulsory and that every organisational member was obliged to participate, the programme still had to compete with other projects, particularly those which were likely to generate income for the organisation.

Evidence from both cases points to a different conclusion from that commonly highlighted in the project management and strategic management literature. In project management terms, a project typically contains four stages: articulation, conceptualisation, development and operationalisation (e.g. Cooper 1988; Lemaitre and Stenier 1988). This assumes that project priority only has importance at and prior to the articulation stage. In other words, to gain the required resources and to get projects sanctioned are the key goals at the outset of the project life cycle. The importance of project priority and of maintaining it throughout the life cycle of the project is generally ignored. In the two cases, the programmes had particularly long life spans and the programme priority needed to be sustained through virtually every stage of the programme.

6.3.2 The process of priority maintaining

According to the strategic management literature, the way in which organisations prioritise their activities is an issue of resource allocation. It is understood that organisations selectively prioritise newly initiated projects with ongoing business activities based on their available resources (Case and Shane 1998). As articulated by decision-making and strategy formulation studies, resource allocation is regarded as an institutionalised form of calculating the potential benefits and risks that each project is likely to produce (Mamaghani 1999; Capron, Dussauge and Mitchell 1998). For example, based on prospect theory, Case and Shane (1998) indicate that:

> '*the risk propensity of the project team is influenced by the project's likelihood of success, the anticipated value or payoff to the firm if the project is successful, the project's priority for resources from the firm, and by the terminal value of the project to the firm in the event the project is killed*' (p: 766).

The findings abstracted from the analysis of the two cases tend to confirm the basic argument advanced by resource-allocation studies. However, the evidence of the two cases also suggests that resource allocation is not merely an objective calculation of the pros and cons of the project outcome; it is also an ongoing socialisation process through which project priority is constantly influenced by the interaction between the core team members, the programme participants, and other organisational members, mainly the top management. In other words, the social relationships between these three groups of people influence the way in which project priority is considered and maintained. For instance, in the GFM case some programme participants were willing to devote more

time and to share vital knowledge because of their social relationships with the core team, particularly with the team leader. This confirms the observation made by Burt (1992) and Nahapiet and Ghoshal (1998) that members of a social network benefit from better access, timing and referrals of knowledge than do those who do not belong to the network. Moreover, the social relationship between the core team and the top management also influences and contributes to the maintenance of project priority. In the GFM case, on the basis of his past performance, the team leader had gained sufficient trust -- both 'competence trust' and 'companion trust' in Newell and Swan's (2000) terminology -- from the top management. In other words, the top management were confident that the team leader could deliver the programme outcome. Hence, the task-oriented and socio-emotional relationship between the top management and the team leader influenced the GMP team in securing resources and helped to maintain project priority.

Our analysis of the two cases suggests that prioritisation can be understood from two perspectives. First, it can be considered as a decision-making process which represents the formal and objective measurement of risks and benefits. For instance, in the BTC case, the interviewees argued that the key benefit of implementing new business processes was that this would help to sustain BTC's competitive advantage. In the GFM case, it was argued that the potential risk of failing to ensure that systems were millennium compliant would mean a loss of income and damage to the company's reputation. Secondly, prioritisation can be perceived as a social construction process in which the priority is shaped through the interaction between the core team members, the programme participants and the top management. The data from the two cases suggest

that the social construction aspect, often neglected in the strategic and project management literature, served as an alternative but critical approach to understanding the process of resource allocation and maintaining priority within the cross-functional project team context. Hence, this prioritisation process is influenced by two interrelated sources: the measurement of benefits and risk, and the social relationship between the core team members and other members of staff in the organisation.

6.3.3 Priority maintaining and the cost of knowledge-related activities

It is clear, then, that prioritisation is not only the representation of organisational objectives formulated by some of the key organisational members; it also denotes a collective socialisation process which triggers knowledge integration. One of the critical issues emerging from this discussion is the importance of resources in relation to the ongoing nature of cross-functional programmes and their underlying knowledge-related activities. In the two cases, knowledge-related activities (including knowledge sharing, knowledge creation, and both formal and informal learning) required resources such as time and money. For instance, in the BTC case it was understood that to have organisational members participate in the programme was equivalent to taking away a large amount of person-hours from each business unit. In the GFM case, to conduct several hours of company-wide IT systems testing or business contingency practice drills meant that every organisational member had to put away his/her work during this period of time. As Demsetz (1991) points out, '*knowledge is costly to produce, maintain and use*' (p.172). This is particularly apparent in contexts where knowledge is being integrated across various organisational units, as is evident in the two cases. Referring back to the concept of resource allocation elaborated earlier, it is understandable that due

to the limitation of available resources only selective knowledge-related activities took place within the organisations. And the selection of these activities was based on the objectives of each organisation as well as the social relationships between organisational members. This therefore offers an additional explanation to the views expressed in the current literature, and helps us to understand why some knowledge-related activities seldom take place in an organisation. For instance, the current literature (e.g. Hansen 1999; O'Dell and Grayson 1998) often considers knowledge sharing as a social or psychological issue and ignores the issue of the resources needed for knowledge sharing. In other words, organisational members who do not share knowledge with others are dealt with on the basis of their unwillingness to do so. The present study, however, emphasises that the real issue may be that there are no resources available to enable the sharing activity to take place.

The research findings suggest that priority maintaining did not mean the same thing to organisational members who were involved in the programme (whether full- or part-time) and those who were not involved. Viewed from the core team's perspective, the maintenance of programme priority meant ensuring that resources available were sufficient to cover the costs, and that the programme was managed. From the top management's point of view, the maintenance of programme priority meant demonstrating their beliefs that the programme would eventually deliver more profits than the resources consumed and the costs incurred. The viewpoint held by the programme participants, as the main contributors of resources in the two cases, was different again: for them, maintaining project priority was not only a matter of showing their obligation and commitment to the organisation; it was also clear that such

obligation and commitment served as a means of expanding and maintaining their social networks by gaining recognition from other network members. Thus, the process of priority maintaining involved an effort to achieve an acceptable consensus despite the variance in motivations. This provides a good example of what Boyce (1995) and Harmon (1990) describe as '*collective sense-making*'.

The discussion of priority maintaining also provides insights into how knowledge-related activities are prioritised within the organisation, thus helping to fill a gap in the organisational knowledge literature. The research evidence suggests that in the two cases priority maintaining was not merely a matter of the programme's survival, but also served to energise various knowledge-related activities taking place within the programme. Furthermore, the way in which knowledge-related activities are prioritised can be regarded as an issue of how resources in an organisation are located. Referring back to the previous discussion, it is clear that the prioritisation of knowledge-related activities in the two case studies was based on two closely related issues. First, it involved the objective assessment of each programme's advantages and disadvantages. Secondly, it was influenced by the social relationships amongst organisational members.

6.3.4 Actions taken to maintain programme priority

The evidence drawn from the two cases suggests that the actions taken to maintain programme priority can be analysed from two perspectives. First, the aim was to achieve *intellectual* buy-in. This refers to the way in which the core team members persuaded the programme participants and other stakeholders, such as the top management, about the importance of the programme and advantages the programme would deliver. Secondly,

the aim was to achieve *emotional* buy-in. This refers to the various approaches taken by the core team members to influence the stakeholders emotionally to support the ongoing programme.

6.3.4.1 Achieving intellectual buy-in

The case-study evidence suggests that one of the major tasks performed by the core team members was to achieve intellectual buy-in from the programme participants as well as other stakeholders, mainly the top management. In order to maintain programme priority, the core team members were constantly engaged in various activities, such as organising meetings with various business units or informal social interactions, as a means of influencing the stakeholders. Viewed from the top management's position, team members not only demonstrated the importance of the programme to the organisation, but also negotiated with the top management to get the programme sanctioned on a regular basis to ensure that the resources needed for the programme were available throughout the various stages of the programme.

Viewed from the programme participants' position, the core team members were seen to promote and disseminate the programme concept to them because the participants were the primary contributors and also the eventual end users of the programme. To achieve intellectual buy-in was not simply a matter of convincing the participants to adopt new ideas at the intellectual level; it was also about creating a certain amount of dissatisfaction so that the project participants would discard old practices and undertake new ones. This is similar to Senge's (1991) account of the tension between reality and vision as a motivation to encourage generative learning. For instance, in the BTC case it

was found that for organisational members to adopt the new business processes, the core BPR team members were continuously communicating with various stakeholders to stress the likely positive outcomes of those processes. Also, according to the core team members, it was vital to provide financial figures and evidence to demonstrate the advantages of adopting the new business processes. Similar evidence found in the GFM case suggests that intellectual buy-in was achieved through continuous communication with the end users and the technologists. The major difficulty involved in achieving intellectual buy-in was the need to find sufficient time from the end users to do the testing. The early GFM initiative provided a substantial time scale for the team to plan the programme so that the implementation of the GMP would not clash with other business activities. By achieving intellectual buy-in, there was a clear sense that the core team and the stakeholders, mainly the programme participants, would share the same understanding of the issues and their significance for the organisation. This phenomenon can be called 'intellectual alignment'. However, evidence also suggests that to achieve such alignment, is not sufficient to maintain programme priority. What is also needed is emotional buy-in.

6.3.4.2 Achieving emotional buy-in

In both case studies, engaging the programme participants and possibly the top management in the programme facilitated the achievement of emotional buy-in. The aim was not merely to increase their awareness of problems and their significance, but to create opportunities for the core team members to establish social relationships with the stakeholders. In the GFM case, the GMP team was continuously educating the stakeholders about the importance of system compliance in relation to business

reputation. By understanding the significance of this problem, the stakeholders, including the programme participants and the top management, were also persuaded at the emotional level. In the BTC case, it is clear that simply engaging the stakeholders to increase their awareness of the problem was not sufficient. It was also vital to engage these groups in planning and redesign. This was because solutions were formulated based on the programme participants' ideas, and therefore it was unlikely that the participants would go against these solutions. By engaging in problem identification, planning, redesign and implementation, a sense of belonging was gradually developed. The stakeholders were emotionally more willing to maintain the project priority once they perceived that they co-owned the programme with the core team members.

Hence, it was clear that to achieve emotional buy-in required the stakeholders not only to recognise the problems but also to recognise their own contributions to solving these problems. This can be partly explained by drawing on the concept of 'emotional attachment' suggested by Lembke and Wilson (1998). They stress that the aim of teamwork is not merely to pool various knowledge and skills. More importantly, it is to have members emotionally attached together as a means of achieving superior performance. However, the term 'emotional attachment' does not fully capture the dynamics observed in the two cases, particularly within the cross-functional project team context. This is because in Lembke and Wilson's study teams are primarily perceived as closed systems that are isolated from their broader organisational contexts. Hence, the concept of emotional attachment falls short of explaining the emotional relationships between the core team, the programme team and the rest of the organisation. It tends to reflect the fairly limited view of the cross-functional programme team as a 'loosely

coupled system' (Orton and Weick 1990). This is why the present study favours the term 'emotional buy-in' rather than 'emotional attachment' to indicate the emotional element in the broader organisational context.

6.3.5 Issues influencing the priority maintaining process

The priority-maintenance process appears to be influenced by two main sets of factors: intellectual and emotional. In reality, these are closely connected.

6.3.5.1 The intellectual aspect

'Intellectual' here refers to rational and objective elements underlying the individual's thinking processes. In the case studies, several issues from the intellectual aspect were found to have influenced the process of priority maintenance. Two of these issues are selected here as the anchor point for this part of discussion: the demonstration of the programme's progress, and the dissemination of programme information. In the following sections, other issues also deemed to be relevant are highlighted.

6.3.5.1.1 The progress of the programme

In both cases, in order to ensure that the resources needed by the programme could be obtained continuously, planned milestones were identified and monitored. The progress of the programme was seen in terms of both tangible and symbolic meanings. The key milestones achieved by both the BPR and GMP teams meant that current practices were gradually improved, e.g. through the implementation of new business processes and the minimisation of potential risk (as in the compliance of IT systems). These were all tangible outcomes delivered to the organisation. Additionally, the progress made by the

two teams also demonstrated their capability and efficiency in implementing their programmes. This had a symbolic meaning.

The tangible and symbolic meanings associated with each programme's progress were intertwined. The evidence suggests that the tangible outcomes delivered by the team helped to strengthen the stakeholders' belief that the team would succeed in the future. This is what Newell and Swan (2000) define as 'competence trust'. As a result, the stakeholders were willing to invest more effort and time in the programme, because the achievements meant that they had become convinced intellectually. In other words, tangible progress led to intellectual buy-in by the stakeholders. The role of intellectual buy-in was particularly crucial when the programme moved from one stage to the next. For instance, in the BTC case new business processes generated during the redesign stage and approved by the majority of the stakeholders helped to secure programme priority in terms of implementation. Similarly, in the GFM case, when the approaches to rolling out the Y2K programme were agreed by the end users, the timetable for implementing the programme was also arranged. This helped the core team to secure and obtain sufficient time from the end users. The trust and support of the stakeholders were obtained and enhanced along with the progress of the programme. Also, ensuring that the stakeholders were aware of the programme's progress was equally critical to the achievement of programme milestones. This pinpoints another vital issue, namely how programme information was disseminated to the stakeholders and shared by organisational members involved in the programme in relation to the process of priority maintenance.

6.3.5.1.2 Information sharing

In both cases, the way in which programme information was shared amongst all stakeholders played a crucial role in relation to the process of priority maintenance. The importance of information sharing has been widely discussed in the literature (e.g. Combs 1993; Solomon 1998; Vadlamani 1997). In particular, in the innovation and project management literature, it is argued that making information available to all departments collaborating on R&D projects is vital in order to ensure project success (e.g. Moenaert; Souder 1990; Souder 1988). In addition, information sharing has an influence on the process of priority maintenance. As already explained, one key issue behind information sharing is how stakeholders get to know about the progress of the programme. In the case study firms, monthly reports, appraisal systems and meetings were set up to inform the stakeholders. Both programme teams used the Intranet as a vehicle to illustrate the programme's development and to emphasise the progress that had been made. This was particularly apparent in the GFM case, where the Intranet was used to inform stakeholders located in overseas branches. However, evidence from the two cases suggests that the use of the Intranet did not always achieve the expected outcome, because the use of the Intranet was not a common practice in either organisation, especially among senior managers. Instead, face-to-face interactions (either formal or informal), e-mails and phone calls were preferred.

The two case-study firms adopted different approaches to sharing programme-related information. In contrast to the centralised approach observed in the GFM case, the approach employed in the BTC case was comparatively decentralised, particularly during the implementation stage. The GMP team acted as a centre for the gathering and

documentation of all Y2K-related information. This was then distributed to various units and individuals involved in the programme. There was very little need for sharing information between different branches, except for the case of some IT systems which were used on a global scale.

The approach used in the BTC case became gradually more decentralised as the programme progressed. Information was centrally controlled and distributed by the core team, particularly during the planning and redesign stages. During the implementation stage, the process of information sharing became decentralised: information related to the BPR programme was distributed according to each individual's decisions. In other words, it was up to the core team members and the programme participants to decide who to send the information to.

In relation to the issue of priority maintenance, the two approaches differed in their influences on the programme. In the BTC case, along with the progress of the BPR programme it was virtually impossible to have a central function which controlled all relevant information flows. In particular, the programme evolved in such a way that its various distinct projects all had very different foci and end user groups to target. Hence, the 'BPR community' was further split into various sub-communities, such as the Sales Plan community and the Space Management community. Each project's priority was maintained somewhat differently, and there was a degree of inconsistency between projects.

By contrast, the approach used in the GFM case appeared to be more efficient in ensuring the sharing of information amongst participants. However, the approach also had certain disadvantages: more effort was needed from the core team; and formal and informal interactions between different branches were diminished. In both case companies, the decentralised approach helped to build up coherence between the participants, thus confirming the findings of Kreiner and Schultz (1993), who suggest that information-sharing facilitates the formation of social networks, and such networks are critical to enhancing collaboration in R&D projects. However, the lack of a central function to maintain the programme's priority is likely to delay the progress of the programme. Hence, each of the approaches in the two case studies had its strengths and weaknesses. The centralised approach did not necessarily outperform the decentralised approach, particularly from the perspective of enhancing the coherence between the participants. On the other hand, the centralised approach appeared to be more stable and consistent than the decentralised approach with regard to ensuring the maintenance of programme priority.

6.3.5.2 The emotional aspect

In both cases, the issues which influenced the process of priority maintaining were not merely related to the value that each cross-functional programme could deliver. The emotional aspect was also vitally important. Within this section, two issues are addressed: the shared ownership of the programme, and the reconfiguration of social networks and trust.

6.3.5.2.1 The shared ownership of the programme

In both case studies, the teams were responsible for the success of their programmes. However, ownership of the programme was shared amongst all participants. This helped to bring the programme participants together emotionally, and a 'sense of belongingness' (Alpander 1991) developed, but with the further development of the programme, this was not sufficient to hold the participants together. This was clear in the early stage of the two programmes, when the majority of programme participants had their 'community memberships' (Brown and Duguid 1991) but not the authority to make the final decisions. Eventually, programme co-ownership became one of the major motivations which stirred participants' interest in carrying on their involvement in the programme (Bowen, Clark, Holloway and Wheelwright 1994; Slonina 1996; Zairi and Letza 1994), in particular during the implementation stage. Although shared ownership was equally vital to both case companies, the way in which it was developed differed. In the GFM case, it was found that the concept of programme ownership meant different things to the team and the programme participants, particularly the end users. In other words, the GMP team physically owned the programme by having the responsibility for ensuring that all IT systems in the company were millennium compliant; and the end users shared the ownership by owning each system they used on a daily basis. Even though the end users did not own the programme physically, they were responsible for the systems they were in charge of in relation to generating income for the company. Hence, it was clear that the GMP team acted like a 'service provider' who serviced different systems for different end users.

In the BTC case, programme ownership was gradually shifted to the participants and away from central control by the BPR team. This was because the team found that owning the programme meant gaining the credit while also taking the risk. They had to 'beg' the participants for support and resources, because they would eventually become the end users of the new business processes. It was argued by the team members that transferring the ownership to the participants meant that it was up to the participants to implement the new processes. The BPR team members thus became facilitators for the various projects which formed the BPR programme. Despite the fact that the core team still had the responsibility for ensuring that the programme was implemented, the transfer of ownership to the participants helped the core team to maintain the programme's priority.

6.3.5.2.2 The reconfiguration of social networks

Another issue containing emotional elements that exerted a significant influence on the process of priority maintaining was the reconfiguration of social networks between the core team and the programme participants, and between the programme participants and the rest of the organisation. The term 'reconfiguration' here refers to the dynamics which portray the continuous change of the social network landscape within a cross-functional programme team context.

It was clear in the two cases that by engaging in the programme, either on a full- or part-time basis, the participants were able to exchange ideas and develop interpersonal relationships with others. New social networks in parallel to the formal programme structure were gradually developed amongst the participants in addition to their existing

social networks. The importance of social networks is reflected in the concept of 'social capital' proposed by Nahapiet and Ghoshal (1998), who see such capital as a joint resource shared by all parties in a relationship. In the two cases, the social networks were developed and reconfigured in different ways. In the BTC case, various social networks were intensively developed when the BPR programme was split into various projects. Overlaps, or network ties (Nahapiet and Ghoshal 1998; Scott 1992; Wasserman and Faust 1994), between the various social networks were also found, particularly among those participants who were engaged in more than one project. In the GFM case, the GMP team was the core to which various social networks were linked, and there was very little overlap between different networks. In other words, social networks were developed on a regional basis. The core team was the only part of the programme which had social interactions with all the different regions.

Although it is argued that social networks help organisational members to gain access to vital information (Nahapiet and Ghoshal 1998), it was found in the BTC case that overlaps between networks could create a degree of distraction to the priority-maintenance process. In particular, participants who belonged to various social networks often found it hard to give the same priority to several projects. In both cases, it was understood that the development of social networks helped to maintain the programme priority by facilitating the achievement of emotional buy-in. However, when the landscape of social networks was 'overdeveloped' or the social capital became 'too rich', this often had a negative influence on the priority maintaining process.

6.3.6 Summary of the priority maintaining process

The above discussion has highlighted the importance of maintaining programme priority in relation to cross-functional knowledge integration. We have seen that the maintenance of programme priority is not just a matter of achieving *intellectual* buy-in to ensure the availability of resources from other organisational units. Of equal importance is the need to achieve *emotional* buy-in as a means of gaining support from the programme's stakeholders. It is also clear from the above discussion that numerous factors influence the priority maintaining process, and in two distinctive but interrelated ways. In the case studies, for instance, the programme itself was vital for demonstrating tangible outcomes and building competence trust between the programme participants and the stakeholders, in particular top management. The centralised and decentralised approaches to information sharing both demonstrated some advantages and some disadvantages related to cross-functional knowledge integration. The transfer of programme ownership from the team to the end users played a vital role in achieving emotional buy-in. The reconfiguration of information networks between the core team, the programme participants and the rest of the organisation meant that new networks were gradually developed in addition to the existing ones. This helped to maintain the programme priority by facilitating the achievement of emotional buy-in.

Boundary penetrating and the maintenance of programme priority are the first two of four identified processes of cross-functional knowledge integration. We shall now turn to consider the third process: paradigm expanding.

6.4 The Process of Paradigm Expanding

The term 'paradigm expanding' refers to the process by which a consensus is gradually developed from different theoretical and methodological rules, procedures and standards practised and assured by the programme participants. Kuhn (1970) argues that each scientific community has its own distinctive paradigm which refers to shared examples, core values and a mindset. Various studies have used different terms and adopted different approaches to describing the concept of paradigm and explaining how a paradigm is formed within the organisational context. For example, Tajfel and Turner (1985) see the development of paradigms as one of the major elements in the formation of social identifies. According to Schein (1996), there are certain paradigmatic differences between executives, engineers and operators, and these reflect three different organisational subcultures, each with its own paradigm. This study extends the concept of paradigm to embrace the shared examples, core values and the mindset embedded in programme participants' own 'communities'.

The research findings show that programme participants from different organisational units had their own sets of beliefs in terms of how work should be done and according to what standards. One of the key challenges in integrating knowledge within the cross-functional programme team context is to synthesise different paradigms pursued by the programme participants. In the section that follows seven specific issues will be discussed: (1) the nature of paradigms; (2) the paradigm expanding process within the cross-functional programme team context; (3) paradigm expanding and collective sense-making; (4) paradigm expanding and the process of developing a collective mind; (5)

paradigm expanding and the distribution of power in the programme team; (6) managing paradigmatic differences; and (7) issues influencing the process of paradigm expanding.

6.4.1 The Nature of Paradigms

Following the concept of 'community of practice' (Brown and Duguid 1991), we may say that each community has its characteristic way of constructing knowledge through distinctive norms, standards and practices. Brown and Duguid (1991) further suggest that story-telling through informal social interaction is one of the main approaches to sharing knowledge among community members. Shared narratives serve not only as one of the major influences on the development of community identity, but also as the representation of a community paradigm. Such shared narratives are articulated from lessons learnt by the community members through their experiences gained in solving novel problems. Thus, a paradigm is developed based on a group of organisational members who are engaged in similar practices. Extending this concept one step further, we may say that a paradigm represents not only similarities in terms of what people know, but also overlaps in terms of what people do, as is suggested by the concept of 'knowing' (Blackler 1995).

In the two cases, distinctive paradigms were more often found in relation to the activities of organisational members than in the organisational units in which these members worked. For instance, in the BTC case, activities such as preparing and co-ordinating sales promotions were not exclusive to the Marketing Department. Some organisational members in the Beauty, Healthcare and Leisure business units also organised sales promotion activities for their own products. Thus, overlaps in expertise and activities

reflect paradigmatic similarities in terms of what people know and what they do. Similarly, in the GFM case, organisational members engaged in the development and maintenance of technologies were spread out over different parts of the organisation. The similarities found amongst these organisational members were based not only on their expertise, but also on their activities. Hence, paradigms were not necessarily bounded by the formal organisational structure. Rather, from the evidence abstracted from the two cases, paradigms were often cross-departmental. This is also reflected in the study of Schein (1996), who argues that subcultural groups within organisations are based on the nature of jobs and not on the departments in which people work. Hence, paradigms are practice-based and are often cross-departmental.

Paradigms are also socially constructed (Berger and Luckmann 1967). By synthesising Kuhn's (1970) definition of paradigm and Blackler's (1995) concept of knowing, we may say that the way in which knowledge is constructed serves as one of the most useful approaches to understanding the nature of paradigms. In the two cases, knowledge was created and shared within the cross-functional programme teams through intensive social interactions amongst the programme participants. This mirrors the idea of a 'community of practice' within which a community paradigm is developed gradually by sharing stories and informal interactions amongst the community members. Furthermore, the context-dependent nature of knowledge (Nonaka and Konno 1998) is also found in paradigms. Based on the illustration by Kuhn (1970) of how paradigms were formed, it is clear that the social context in which commonly accepted rules, standards and practices are constructed plays a vital role in explaining why one paradigm makes sense to one group of people but not another. This phenomenon is

particularly evident in the cross-functional programme teams, where planning and redesign stages appear to be problematic and consensus on implementation methods is difficult to reach. This points to another aspect of paradigm, which is its stickiness. As Kuhn (1970) argues, the evolution of a new paradigm often takes a long period of time, and any person's paradigm is deeply rooted within him/her. Therefore, it is not easy to change a person's paradigm because of this quality of stickiness. This explains why programmes, such as BPR, that required fundamental paradigmatic change, can often be more problematic than programmes like GMP. Also, the difficulties involved in making paradigmatic change explained why, in this study, the term 'paradigm expanding' is preferred to 'paradigm shift' (e.g. Chia 1996).

6.4.2 Paradigm expanding within cross-functional programme teams

In both the case studies, paradigmatic differences were found not only between core team members, but also between programme participants and between those participants and the rest of the organisation. These differences arose from the process of selection of core team members and programme participants. Both programmes were designed to have a company-wide coverage. Hence, the core team members and programme participants were selected from virtually every part of the organisation to ensure the representativeness of those programmes. In forming cross-functional programmes, the need for creativity and hence diversity (Hauser 1998; Tushman and Nadler 1986; Wheelwright and Clark 1992) inevitably created difficulties in leveraging, and benefiting from, the paradigmatic differences. In both cases, these differences had a positive and negative influence on the programme (Shaw and Barrett-Power 1998). Thus, they served as one of the critical sources for stimulating new solutions through

criticising, negotiating, socialising and compromising. In the BTC case, for example, a new standardised measurement of store profitability was triggered by the different perspectives held by stores, regional offices and the head office, especially the Beauty, Healthcare and Leisure business units. For the stores and regional offices, their major concerns were how to achieve sales targets regardless of the products they sold, how much store space they used, and how much they had to spend to generate such targets. For the Beauty, Healthcare and Leisure business units, their main concern was to have as much store space as possible for displaying their products in order to achieve their sales targets. The new measurement was created to ensure the cost-efficiency of store space, as well as to provide equal opportunities for stocking the three product ranges. In the GFM case, the adoption of a standardised documentation procedure, as an innovative approach to the organisation, was inspired by the different perspectives of its global programme participants. Other evidence can be found in the innovation literature to highlight the benefits of involving different perspectives in R&D and process innovation projects for stimulating new ideas and generating alternative solutions (Cooper 1986; Davenport 1992; Sounder 1988).

At the same time, however, paradigmatic differences (in both cases) led to conflicts within the programme team, thereby slowing down the progress of the programme. Similar evidence can be found in various empirical studies (e.g. Johnson and Johnson 1982; Smith and Berg 1987). Another disadvantage of paradigmatic differences is illustrated by Dougherty (1992), who showed how different interpretations, derived from paradigmatic differences in a new product development team, often caused breakdowns and resulted in the failure of the project.

This study uses the term 'paradigm expanding' not only to suggest the inappropriateness of 'paradigm shift', but also to elaborate the dynamics of how different paradigms interacted within the programme teams. It appears that paradigmatic differences between programme participants were gradually lessened as the programme progressed. In other words, such differences were more apparent during the planning stage than during the implementation stage. This change does not mean that the programme participants shifted their paradigms from one stage to another. Rather, they *expanded* their paradigms to create overlaps with other paradigms pursued by other participants. For instance, it was understood in the BTC case that even though the production of a fundamental paradigmatic change was the ultimate goal of the BPR programme, there was no evidence to support such dramatic and revolutionary change. Despite the fact that programme participants became familiar with new business processes and gradually adapted to them, the participants did not abandon all the practices they had learnt from past experience. Instead, they blended the new processes into their existing practices.

In the GFM case, the diminishing of paradigmatic differences was also observed, particularly in those participants who were new to the programme and were either recruited from other companies or selected from different organisational units. They gradually learnt and adapted to the rules, expectations, instruments and standards related to the GMP. This does not mean that they had to change their paradigms completely in order to fit in with the new practices. Rather, through learning and adaptation, they were able to expand their paradigms to accept different sets of practices that existed within the programme team. In other words, overlaps between different participants' paradigms

were developed, and conflicts created by paradigmatic differences were reduced. The following section will examine the actions taken by the team members to overcome the paradigmatic differences amongst the programme participants.

6.4.3 Paradigm expanding and collective sense-making

During various stages of the programmes, in the two cases, core team members worked collectively with the participants not only to generate new ideas, but also to seek commonly acceptable ways for implementing those ideas. As the programmes progressed, the core team members and the programme participants were constantly engaged in the process of problem solving, as well as making sense of problems faced and solutions generated. The core team members might have had a better understanding of the subject than most of the programme participants at the initial stage of the programme. However, when the programme reached the implementation stage, the gap between the core team members and the rest of the programme participants was reduced. This was not only because the participants had gradually learnt about the concept, but also because the core team members themselves did not have any hands-on experience of implementing the programme. For instance, in the BTC case the core team members had learnt the concept of BPR earlier than most of the participants from the external consultancy team hired by the organisation in 1997. However, they had never actually been involved in a programme like this before. This was also true in the GFM case. Even though some of the core team members who were recruited externally had been involved in similar programmes before, none of them could be certain that the way they were doing things was certain to prevent the 'millennium bug'. This suggests that from a certain stage the programme participants and the core team members had

more or less the same degree of understanding of, but also a similar lack of familiarity with, the programme. Hence, it was clear that the programme participants and the core team members needed to make sense of what they faced. These activities reflect what Boyce (1995) calls 'collective sense-making', defined as '*the process whereby groups interactively create social reality, which becomes the organisational reality*' (p: 109). This suggested that collective sense-making can be considered not only a social construction process (Berger and Luckmann 1967), but also a knowledge creation and knowledge integration process. Thus, shared meanings developed within the group could appear as intersections or overlaps of different paradigms co-existing in the group. This echoes one of the key arguments in this study: that in order to integrate knowledge within the cross-functional programme team context, programme participants need to expand their paradigms to create overlaps or redundancies with other paradigms.

The major difference between Boyce's (1995) work and this study lies in the way in which individual differences within the group, particularly their knowledge backgrounds and experience, are considered. In Boyce's study, despite individual members having different perspectives and opinions on the same issue, each member had a broadly similar degree of understanding of the subject. In the two cases presented here, however, it is clear that at the initial stage of the programme, most of the programme participants knew very little about the subject compared with the core team members. Hence, the concept of collective sense-making cannot easily be applied to every stage of the two programmes, particularly the initial stage. This is because most of the programme participants were still facing steep learning curves when they first participated in the programme. It would thus be a mistake to classify individual learning at the initial stage

as a collective sense-making activity. Furthermore, one of the vital factors in Boyce's work is a coherent social relationship amongst group members. It is clear that this element was not found until the programme participants had spent a substantial amount of time socialising with other participants. Hence, the concept of paradigm expanding portrays the continuous knowledge integration process throughout the programme's life cycle, whereas the concept of collective sense-making refers to the stage at which group members build up a similar amount of understanding on the subject and a substantial social relationship with each other.

6.4.4 Paradigm expanding and the process of developing a 'collective mind'

Weick and Roberts (1993) use the term 'collective mind' to refer to the way in which different actors within a social system maintain performance reliability by developing heedful interrelations between their actions. This suggests some theoretical overlaps with the process of paradigm expanding. As each programme progressed, co-ordination between the programme participants gradually improved. In the planning stage, there were various interests and orientations towards the future direction of the programme. Conflict and disagreement were more often found at this stage than others, and co-ordination between the programme participants was also problematic. The lack of a 'collective mind' explains why co-ordination amongst the programme team members was particularly poor at the initial stage. This is a common phenomenon within cross-functional programme teams, as in the BPR programme and the GMP. Another interesting similarity concerns the physical dispersion of participating members. In Weick and Roberts's study of an aircraft carrier, the air crew, air traffic controllers and the logistics staff were not physically located in the same place, which mirrors the

dispersion of participants in the two case study programmes. This suggests that being physically together is not a necessary issue in terms of developing a collective mind.

The differences between the two programmes in this study and the aircraft carrier studied by Weick and Roberts mainly relate to the nature of the operation in question and the social context in which the collective mind is nurtured. First, it is clear that the nature of operating an aircraft carrier is very different from implementing a new cross-functional programme in an organisation. Thus, people involved in operating the aircraft carrier had the opportunity to learn from one operation and to apply that knowledge to the next one. Hence, the collective mind was developed through continuous practices and repetitions. The two programmes in this study, however, were not only new to the two case companies, but also were understood to be unique 'one offs'. Hence, there were very few opportunities for the participants to learn from repetitions. Instead, it was more a case of learning-by-doing and trial and error. Thus, a collective mind was developed based on the increasing overlaps between different participants' paradigms, and such overlaps were developed through the process of paradigm expanding.

Secondly, the social context in Weick and Roberts's (1993) study is less hierarchical than that in the two cases examined here. This also points to one of the gaps in their study, since in the aircraft carrier case the issue of power was not significant. In other words, co-ordination amongst the participants was based on mutual dependence rather than being driven by the exercise of power. The evidence from the two case study firms suggests that within a cross-functional programme context it is more a case of core team members relying on the participants for resources. Additionally, in both cases power was

exerted during different stages in different situations, whereas in the aircraft carrier operation there was a 'power-free zone'.

6.4.5 Paradigm expanding and the distribution of power in the programme team

This section focuses on the influence of power on the process of paradigm expanding. It is clear from the two cases that programme participants from various organisational units differed not only in terms of their knowledge backgrounds but also in terms of the power they could exert over other participants (Lukes 1974). As already explained, different approaches were employed to penetrate boundaries, and one of them involved gaining legitimate power from the top management. Also, power was exerted in the process of paradigm expanding. This was particularly apparent when the power distribution was rather unequal between the participants (Brass and Burkhardt 1993; Feldman 1999; Linnehan and Konrad 1999).

For instance, in the GFM case the standardised documentation approach was introduced by the team leader. Other participants rarely had any opportunities, or found it difficult, to suggest other alternatives. This reflects the concept of 'naked power' (Lukes 1974), which is observed when differences are reconciled through the more powerful imposing their interests on others. It is clear from the GFM case that other programme participants were 'forced' to expand their paradigms to demonstrate their sense of obligation. Also, paradigmatic differences were often influenced by the power individuals or business units had over others. This power was defined by most of the interviewees as the ability to make money for the organisation. This observation mirrors the study of Linnehan and Konrad (1999), who argue that inter-group inequality can serve as a lens to identify

power relationships within organisations. Similarly, in the BTC case power was often used as a means of managing paradigmatic differences. For example, some organisational members did not feel capable of integrating change into their jobs, and they were therefore encouraged to leave the organisation (although in no case did this actually happen). Additionally, the Beauty, Healthcare and Leisure business units, as part of the profit-making centre, played dominant roles in the BPR programme. In particular, one of them took various actions, including boycotting the programme and disagreeing with the majority, to ensure that other units accepted their suggestions. Thus, it is clear that in the two cases power was exercised not only to manage individual and group differences of interest, but also to create and maintain the collective meaning (Feldman 1999) that served as the foundation for paradigm expanding.

In addition to the situation in which there was an unequal power distribution, the paradigm expanding process amongst the participants was more often triggered by social relationships amongst the participants than the exertion of power itself. In other words, participants' paradigms were expanded through socialising with other participants. The development of social networks amongst the participants was crucial not only to the paradigm expanding process, but also to the processes of boundary penetrating, priority maintaining and organisational memory refining.

6.4.6 Managing paradigmatic differences

The number of organisational members participating in the programmes meant that it was vital to manage paradigmatic differences in order to integrate knowledge cross-functionally. As explained in the previous section, paradigmatic differences could

influence the programmes in both positive and negative ways. Also, from the discussion of collective sense-making and collective mind, it is clear that developing overlaps between different paradigms was vital to the achievement of a shared understanding and to improve co-ordination amongst the participants. The two teams took different approaches to managing the paradigmatic differences even though they had the same desire to maximise the advantages and minimise the disadvantages of those differences.

In the BTC case, representatives from every business unit were brought in not only to ensure that the BPR programme had organisation-wide coverage, but also to invite different ideas and thoughts by increasing the diversity of participant's knowledge backgrounds. In the BTC case, paradigmatic differences were a vital source of innovation (Cox 1991; Hauser 1998; Jarratt 1999), particularly during the planning and redesign stages (McGinnis and Ackelsberg 1983; Tushman and Nadler 1986). This also matches the results of studies by McGrath (1984) and McLeod and Lobel (1992), who argue that diverse groups can be more creative and achieve better quality decisions than homogeneous groups. It is clear that the BPR programme was designed to benefit from, and accommodate, such diversity. However, stories from the BTC case suggest that this design created a tension between the quality of redesigning the new process and the efficiency of implementing the programme. In other words, the programme might benefit from a better process redesign by incorporating different ideas, but on the other hand the price would be the time needed to reach consensus amongst the participants. This dilemma became less obvious when the programme was split into various projects, each with a very specific focus, such as the Space Management project and the Sales Plan project. Also, collective learning and socialising at the group level helped to reduce

the impact of this dilemma by minimising paradigmatic differences amongst the participants.

The approach employed by the GMP team to manage paradigmatic differences was at the other extreme. Instead of encouraging diversity, there was a clear indication that the core team, particularly the team leader, sought to minimise such differences. For instance, the introduction of a centralised documentation approach was intended to ensure that every branch was doing exactly the same thing and following the same schedule to achieve the planned milestones. In other words, paradigmatic differences were suppressed to avoid variance in progress and quality. Furthermore, the programme structure was designed to reduce the need for cross-regional collaboration. With the exception of some IT systems which were used to network the whole organisation and required cross-regional collaboration, the core team was the only part of the programme which needed to have interaction with every part of the programme. Thus, the dilemma faced by BTC was clearly not found in the GFM case. These differences were found not only because the approaches towards paradigmatic differences were different, but also because the programmes differed in terms of their nature and objectives. In other words, the benefits of encouraging group diversity as a means of leveraging innovation and creativity were less significant in the GMP programme than in the BPR programme.

6.4.7 Issues influencing the paradigm expanding process

In the two studied cases, the paradigm expanding process was greatly influenced by perspective taking and mutual learning. Indeed, these two factors also influenced the boundary-expansion and priority-maintenance processes.

6.4.7.1 Perspective taking

The concept of 'perspective taking' has been investigated by Boland and Tenkasi (1995), who argue that each community of knowing, with its specific expertise, has its own perspective. They argue that in order to create and integrate knowledge cross-functionally, it is necessary to take into account other communities' perspectives. Similar arguments can also be found in the innovation literature in discussions of cross-functional R&D projects (e.g. Cooper 1988; Moenaert and Souder 1990). Sessa (1996) takes a different approach to investigating the influence of perspective taking on group dynamics, particularly in relation to the issue of group conflicts. She concludes that perspective taking helps to reduce group conflicts by encouraging team members to perceive differences as the results of different task orientations instead of different people orientations. Both accounts provide useful theoretical foundations for explaining the influence of perspective taking on the process of paradigm expanding: Boland and Tenkasi (1995) from the intellectual perspective, and Sessa (1996) from the emotional perspective.

It is clear that in the two cases perspective taking created different degrees of influence at different stages of the programme. It was particularly crucial in the initial stages, including planning and redesign, because paradigmatic differences were significant. In particular, at the planning stage representatives from different organisational units were not only unfamiliar with the subject, but also did not know most other representatives. Perspective taking at this stage was understood to be beneficial at two interrelated levels: the intellectual and the emotional. In the BTC case, perspective taking at the intellectual

level helped the participants to understand the subject in more detail by taking different perspectives proposed by the core team and other representatives. In other words, programme participants were able to expand their paradigms by taking each other's perspectives into account. This can be linked to the concept of intellectual buy-in discussed in the section on the priority-maintenance process. At the emotional level, perspective taking was useful in reducing the hostile atmosphere within the programme, not only amongst the representatives but also between the representatives and core team members. For instance, some events, such as searching groups or brainstorming, were designed not only to generate new ideas, but also to provide opportunities for the core team members to understand and exchange perspectives with the representatives. More importantly, perspective taking helped to build up social relationships amongst the participants. Overlaps between different paradigms were gradually increased as individual participants became more willing to share their paradigms with others. This illustrates the influence of perspective taking on the process of paradigm expanding at the emotional level.

In the GFM case, the meaning of perspective taking as well as its influence on the process of paradigm expanding was somewhat different. Within the core team, perspective taking was employed by the leader as a tool to ensure programme quality. In other words, at the initial stage of the programme, the leader had to make sure that all core team members had understood his perspective and used it for guidance. Therefore, this was quite different from the exchange process observed in the BTC case. However, between the participants and the core team perspective taking was understood as more of a 'two-way' approach, since the core team, including the leader, needed to exchange

perspectives with others and to take other participants' perspectives. Between the core team and the participants, perspective taking was thus a vital vehicle for bridging paradigmatic gaps at the intellectual level. More importantly, it served as a 'lubricant' to develop social relationships between them, as the core team eventually needed sufficient support to implement the programme. This demonstrates the influence of perspective taking on the process of paradigm expanding at the emotional level.

6.4.7.2 Mutual learning

Another issue that influenced the process of paradigm expanding was mutual learning. The term 'mutual learning' was first used by March (1991) to explain how individuals learn from the collective knowledge of an organisation and simultaneously modify that collective knowledge. In the two case studies, mutual learning did not merely take place between the individuals and the organisation; it also took place between organisational members who participated in the programme with different levels of expertise and different paradigmatic backgrounds. This is why the present analysis seeks to extend March's concept of mutual learning to the learning that takes place between organisational members.

Within cross-functional programme teams, the importance of mutual learning for the process of paradigm expanding is clear. In the two cases, group diversity inspired mutual learning amongst group members, and this was particularly vital for R&D projects which relied heavily on the creation of new knowledge (Cooper 1988; Sounder 1988). Also, group diversity encouraged mutual learning and enhanced group performance (Guzzo and Dickson 1996; Magjuka and Baldwin 1991). It is clear that mutual learning,

like perspective taking, influenced the process of paradigm expanding at both the intellectual and emotional levels. Thus, in the initial stage of the two programmes, participants had very little understanding of the subject. Mutual learning took place mainly between the core team members and the participants, and primarily focused on the concept and methodology related to the programme. In other words, given the absence of social relationships as the key emotional element, mutual learning was limited mainly to the intellectual level. At the initial stage, programme participants learnt from the core team members, but it was also crucial for the latter to learn from the participants.

As each programme progressed, the core team members and the programme participants gradually developed a similar degree of understanding, and sometimes an equal amount of unfamiliarity, with the subject. Mutual learning served as a vital vehicle within the programme to facilitate not only communication but also to generate solutions for problems faced by the programme. This reflects the concept of collective sense-making elaborated in the earlier section. Paradigmatic differences were gradually reduced through mutual learning and by developing overlaps between different paradigms. In addition, it is clear that a certain degree of knowledge redundancy (Madhavan and Grover 1998; Nonaka 1990, 1994; Taylor and Lowe 1997) between the participants eased the mutual learning process and further facilitated the development of paradigmatic overlaps amongst the participants.

In addition to its influence at the intellectual level, mutual learning influenced the paradigm expanding process at the emotional level. As argued by Lave and Wenger

(1991) in their concept of 'situated learning', it is clear that the importance of learning was not simply limited to the acquisition of knowledge and skills. Learning was also understood as a vital socialising process for learners with different experiences. Hence, the social and emotional element embedded within the mutual learning process had a critical influence on the process of paradigm expanding. In both cases, mutual learning at the emotional level only took place when boundaries within the programme were penetrated and social relationships amongst the participants started to germinate. Mutual learning at this level contributed to the achievement of emotional alignment amongst the programme participants and facilitated the development of a collective mind.

6.4.8 Summary of the paradigm expanding process

A paradigm represents not only the distinctiveness of a community but also its activities. The activity-based nature of a paradigm is rooted in various forms of social interaction (Burger and Luckmann 1966), in particular storytelling (Boyce 1995) and sharing narratives (Brown and Duguid 1991; Lave and Wenger 1991; Wenger and Snyder 2000). It is also clear that paradigmatic differences derived from group diversity can serve as a vital source of creativity (Hauser 1998), in particular within cross-functional project teams. But on the other hand, such differences can also slow down the progress of the programme if they lead to inter-group conflict. As explained, the process of paradigm expanding is also similar to the process of collective sense making (Boyce 1995) and the development of a collective mind (Weick and Roberts 1993). However, the concept of paradigm expanding also takes into account the differences in individual's knowledge and subcultural backgrounds – two factors that are overlooked by the other two concepts. Furthermore, as we have shown, the process of paradigm expanding is highly

influenced by the distribution of power between programme participants, and this in turn influences the process of perspective taking. Finally, this study has stressed the influence of perspective taking and mutual learning on paradigm expanding. It is clear from the discussion in Section 6.4.7 that perspective taking (Boland and Tenkasi 1995) served as a vital mechanism to enable a shared understanding between programme participants. And mutual learning (March 1991) enabled the process of paradigm expanding by creating common knowledge (Demsetz 1991) or knowledge redundancy (Nonaka 1994) between the programme participants. The following section discusses the fourth identified process of knowledge integration – organisational memory refining.

6.5 The Process of Organisational Memory Refining

The forth process of knowledge integration abstracted from the data analysis has been termed organisational memory refining. This term is used here to refer to the process by which organisational memory, existing in various forms, is continuously re-examined, challenged, modified and redefined through the social interaction of organisational members during various stages of the cross-functional programme. As illustrated in Chapter Two, it is clear that the notion of organisational memory is particularly useful to explain the existence of a knowledge architecture which is not diminished by the replacement of organisational members (Walsh and Ungson 1991; Weiser and Morrison 1998). Rather, that architecture is enhanced and stimulated by the enrolment of new organisational members as part of the organisational learning processes (Huber 1991) and as a mechanism for knowledge creation (Matusik and Hill 1998).

The following discussion outlines the research findings abstracted from the analysis and compares them with those in the current literature on organisational memory. First, the common features of organisational memory across the two cases are highlighted. Secondly, the actions taken by the programme participants to refine organisational memory are examined. Finally, the factors that influence the organisational memory refining process, including the management of group diversity, transforming information into knowledge, and embedding knowledge into organisational practices, are addressed.

6.5.1 The nature of organisational memory refining

Two common characteristics of the memory refining process are found across the two cases: cross-functionality and continuity. Despite the fact that these two characteristics are discussed separately, this study shows that they are closely interrelated. With an organisation-wide coverage, the two cross-functional programmes demonstrate that the memory refining process occurs not only at the programme level, but also at the organisational level.

6.5.1.1 Cross-functionality

Evidence drawn from the data analysis suggests that the refinement of organisational memory is a process to which all participants contribute collectively. This is reflected in Day's (1994) notion that organisational memory consists of 'collective insights' that are constructed jointly by organisational members. Despite the fact that the GMP and BPR team played the leading roles in implementing the programmes, the memory refining process was not led solely by these two teams. Rather, the process was a joint effort to which a large number of programme participants contributed, including all the

stakeholders who provided ideas and suggestions at the planning and redesign stages of the programme. Also, the influence of organisational memory refining on existing working procedures and organisational routines was evident not only at the programme level, but also at the organisational level, in particular with stakeholders, including the end users.

The cross-functionality of the organisational memory refining process was created through programme design and was reflected in the number of participants from virtually every organisational unit. For instance, in the BTC case, the Macro Space project was composed of participants from the regions, stores, Beauty, Healthcare and Leisure business units, as well as the space management department. Cross-functionality, as one of the main concerns related to the implementation of the BPR programme, sought to ensure that the change in the management of store space could be spread out to all the organisational units influenced by such change. In the GFM case, the people participating in the GMP were from the front, middle and back offices in every branch all over the world. Referring to the multi-level existence of organisational memory (Moorman and Miner 1997), as explained in Chapter Two, it is clear that cross-functionality explains the link between different organisational units to create a synergy. This synergy, based on the concept of loosely coupled systems (Orton and Weick 1990), indicates not only the mutual responsiveness between different forms of organisational memory embedded within different organisational units, but also the distinctiveness of the dispersion of organisational memory (Walsh and Ungson 1991).

Through their involvement at various stages of the project, programme participants from various functions constantly engaged in the refining process by bringing in their knowledge and beliefs, as well as by confronting the different ideas possessed by others. In this process, the BPR and GMP team members acted as facilitators not only to incorporate various thoughts and ideas, but also to ensure that a consensus was reached. For example, referring to the BTC case discussed in Chapter Four, it is clear that during the 'shaping the future' stage, different ideas were confronted and synthesised to reach an agreed direction for the programme redesign. Referring to the GFM case in Chapter Five, it is clear that the different testing approaches proposed by the participants were discussed before finalising a commonly acceptable testing method. The discussion in section 6.2 also shows that the cross-functionality of the organisational memory refining process was evident in the boundary penetrating process. This was particularly apparent when the team tried to gain the support of all organisational units. Through the penetration of different boundaries, the programme participants were able to collectively refine organisational memory as a process of knowledge integration.

6.5.1.2 Continuity

In the innovation and knowledge-management literature, knowledge assets are generally perceived as the outcome of organisational activities (e.g. Brand 1998; Martiny 1998; Zack 1999), rather than as continuous processes underlying these activities. Evidence abstracted from the present analysis suggests that the refinement of organisational memory is not only the outcome of knowledge integration processes. Rather, it is also part of the ongoing knowledge integration processes through which new practices emerge by discarding or combining existing practices, even though refinement can more

easily be recognised as the outcome of implementation. For instance, in the BTC case, the change of store space measurement against product profitability can be seen as the outcome of the organisational memory refining process. However, the organisational memory studies advocate a different viewpoint. They argue that the refinement of organisational memory is incremental (Huber 1991; Walsh and Ungson 1991) and emerges from the gradual progress of activities taking place within the organisation, such as new product development (Moorman and Miner 1997; 1998). In the present study, the two programmes were longer than three years and had various project stages, so organisational memory was gradually refined along with the progress of the programme. Even though it was evident that a radical change was advocated in the BTC case, it was clear that the processes of implementing such change were incremental. Referring to the GFM case elaborated in Chapter Five, it is clear that the way in which the cross-functional programme was implemented was very different from the processes in some other previous projects. The influence of the GMP was also evident in other programme initiatives, such as the development of organisational culture at the beginning of 2000. Here a centralised approach was adopted, and this was quite different from the decentralisation that characterised previous projects. Hence, such continuity cannot be seen purely as the outcome of the programme. Rather, it represents the underlying dynamics of organisational memory refining.

Our analysis reveals that through the incremental absorbing (Levitt and March 1988), diffusing (Ackerman and Halverson 2000) and validating of knowledge (Attewell 1996) by the project participants, knowledge was continuously acquired and renewed. This provides empirical evidence in support of the conceptual arguments advocated by

organisational memory and organisational-learning scholars, such as Huber (1991), Stein and Zwass (1995), and Walsh and Ungson (1991). By adding, discarding and renewing knowledge assets, organisational memory was refined. The discarding of obsolete knowledge and practice is captured by the concept of 'unlearning' (Hedberg 1982; Nystrom and Starbuck 1984). Participants expanded their paradigms by taking in different concepts and ideas, a process facilitated by the mechanism of perspective taking (Boland and Tenkasi 1995). Through this paradigm expanding, the participants embedded what they learnt from the programme into their working procedures. This conforms to the argument of Ackerman and Halverson (2000), who regard organisational memory as the representation of organisational processes through the simultaneous embedding of lessons learnt by employees into their daily routines.

6.5.2 Tactics in organising the process of organisational memory refining

In the two cases, there were similarities and differences in the tactics used to refine organisational memory. First, in the GMP team there was an effort to acquire knowledge from external sources through the employment of consultancy teams. However, there were no contractors in the BTC case. Secondly, documentation was used to codify vital information, although the influence of this documentation on the process of organisational memory refining was not the same in each case. Thirdly, the actual tactics used to refine organisational memory were also different.

6.5.2.1 The use of external expertise and contractors

As we saw in Chapters Four and Five, the two case companies employed external consultancy teams to provide guidance on programme design and implementation.

However, the nature of the expertise found in the two cases was rather different: in the BTC case it involved business process redesign; and in the GFM case it involved expertise related to millennium compliance. Still, this expertise served the same function: it facilitated a process of vicarious learning (Huber 1991) through which the organisations were able to acquire knowledge by channelling knowledge from external sources, e.g. consultants, into the organisation.

Despite the employment of external expertise in both cases, its influence on the implementation of the programme was rather limited. For instance, referring to the BTC case (Chapter Four), feedback from the BPR team suggested that the external consultants were unable to transfer sufficient knowledge to the team. This was mainly a result of a shortage of time. But also there was no mechanism which allowed the BPR team members to acquire such knowledge through 'learning-by-doing' (Arrow 1962). In the GFM case (Chapter Five), there were also limitations in using external expertise. It is clear that without a profound understanding of the IT systems used in NatWest GFM, the external consultants were not able to provide useful knowledge which could be used as a guideline for the organisation of the GMP. This finding confirms the results in some of the knowledge transfer and knowledge diffusion literature, which suggest that the nature of knowledge greatly influences the transfer process. In particular, the communicability of knowledge and the possibility of modifying knowledge into a different organisational context are of vital importance (Attewell 1996; Von Hippel 1988).

In addition to the employment of external consultants, in the GFM case a large number of contractors were recruited as core team members during the implementation and testing stages. The enrolment of new members, most of whom (with one exception) were contractors, was useful for instantly bringing in knowledge which was required by the team. A similar argument for employing contractors as a means of stimulating knowledge creation can be found in the study of Matusik and Hill (1998). The new members -- called 'new blood' by some of the interviewees -- stated that they all faced a steep learning curve when they first joined the organisation. Despite the fact that they had a remarkable amount of experience in their field, they had to learn how things worked in the organisation and what the expectation was from various levels of management. This reflects the concept of 'peripheral legitimate participation' (Lave and Wenger 1991), elaborated in Chapter Two, which captures the social dimension of learning processes between the experienced and the novice. A further advantage of employing contractors (Matusik and Hill 1998) is that they bring with them different ways of working which challenge conventional organisational methods. For instance, one contractor with extensive knowledge in the area of business continuity helped to change existing practice by initiating, introducing and promoting new ways of managing business continuity. In the GFM case, this served as a mechanism to refine the organisational memory that was not only embedded within the organisation but also dispersed in various organisational units.

At the same time, there were several problems related to the use of contractors. First, there is the problem of knowledge loss when contractors finish their contracts and leave the organisation (Matusik and Hill 1998). Similar findings can be found in the study by

Carley (1992), who argues that staff turnover influences the organisation's learning capability because of the reduction of organisational memory. Despite the fact that the GMP programme documented vital information and knowledge which was required by the regulatory bodies, some of the contractors' experience was not codified, in particular lessons related to organising and conducting IT systems testing. Secondly, as elaborated in the case description, it was clear that the steep learning curve faced by the newly joined contractors was not only an intellectual issue but also an emotional one. Even though they had substantial experience and knowledge in managing Y2K programmes, the difficulty of penetrating various boundaries (as illustrated in Section 6.2) inevitably delayed the progress of the programme.

6.5.2.2 Documentation

In addition to the use of external sources of expertise, documentation was also important in relation to the process of organisational memory refining. Even though, in the literature, there is disagreement concerning the usefulness of documentation and the possibility of externalising and codifying knowledge (e.g. Ackerman and Halverson 2000; Nonaka and Takeuchi 1995; Star 1989), the importance of documentation was certainly evident in the two cases. However, the influence of documentation on the process of organisational memory refining was not the same.

In the GFM case, it was clear that one of the key purposes of documentation was to provide the regulatory parties with demonstrable proof. Hence, the GMP team had to systematically codify the progress and the outcome of each test, even though documentation was not a common practice in the organisation. Despite the fact that

documentation was seen as a compulsory practice of the GMP, what individual members learnt and experienced was not incorporated in the documentation. The use of documentation in the GFM case was similar to the use described in other empirical studies (e.g. Elofson and Konsynski 1993; Satzinger, Garfield and Nagasundaram 1999) in the sense that the emphasis was on managing abstract information for the purposes of retrieval. However, the practice of documentation in the BTC case emphasised the basic facts of each project, such as the project objectives, events, participating members and timetable. More importantly, the lessons and personal experience learnt by the core team members and the programme participants were also part of the documentation in the BTC case. This reflects the focus of Anand, Manz and Glick (1998), who stress the importance of managing 'soft knowledge' as part of the approach to refining organisational memory. A comparison of the two cases suggests shows that in the GFM case the documentation was more information-oriented, and in the BTC case it was more knowledge-oriented. These differences in turn had different influences on the organisational memory refining process.

In the GFM case, the influence was indirect and symbolic. As illustrated in Chapter Five, the development of a database by the GMP team represented the intention to systematically codify all IT systems used in the organisation and their modifications, which were previously known only by individual branches and user groups. The establishment of this database was considered as symbolic, because it was more for the purpose of demonstrating the company's millennium compliance than developing a system, or using Caley's (1996) term 'information warehouse', from which organisational members could learn. Furthermore, the impact of documentation on

organisational memory was rather indirect. This was because it was not the information codified in the database that refined the organisational memory; rather, there was a need for documentation that altered the existing practice towards a greater emphasis on codifying IT systems change and modification. By contrast, in the BTC case, the influence of documentation was more direct. With an emphasis on codifying the lessons learnt from various activities of the BPR programme, knowledge was shared between different projects. For instance, issues related to the minimisation of the impact of change in project managers were codified in the BPR database. This was found to facilitate the refining of organisational memory, because programme participants and stakeholders were able to find more applicable knowledge from the database than they could from the system used in the GFM case. This finding confirms the results of some organisational- learning studies that stress the importance of managing learnt lessons for application in future actions (Fiol and Lyles 1985; Jones and Hendry 1994; Seibert 1999).

Such differences in orientation can be linked to the discussion of the knowledge creation and knowledge innovation literature in Chapter Two. In the case of BTC, the knowledge-oriented documentation approach helped the sharing and exchange of knowledge, which was vital for knowledge creation (Nahapiet and Ghoshal 1998). In contrast, the approach taken by the GFM case reflected the concept of information process theory, whose primary emphasis is on the efficiency and accuracy of information distribution (Galbraith 1977; Moenaert and Sounder 1990) rather than on the context-dependent nature of knowledge (Nonaka 1990).

6.5.2.3 Tactics for managing the process of organisational memory refining

It is clear from the accounts presented in Chapters Four and Five that the two teams had very different tactics in managing the process of organisational memory refining. In particular, a centralised approach was used in the GFM case, and a decentralised approach was used in the BTC case. Also, the GMP team took a very different approach to programme implementation compared with the approach taken to other projects within this organisation. Instead of providing brief guidelines and allowing domestic variance, in the early stage of the programme the team leader insisted on applying a standard procedure to the whole global operation. This procedure unified not only the implementation processes but also the quality and outcome of each branch. In the case of the BPR programme (Chapter 4), there was a gradual shift from a centralised to a more decentralised form of management. In particular, this was reflected in the change of the core team members' role from project manager to facilitators.

These two distinctive project management approaches reflected more fundamental differences in terms of how the organisational memory refining processes were organised. The centralised approach was particularly effective in collecting and distributing information, especially to participants who were in different geographic locations and time zones. The efficiency in information processing helped to ensure not only consistency in terms of progress and quality across various organisational units, but also the effectiveness of programme implementation. This highlights an important contrast between the two cases, and explains why some projects in the BPR programme were less successful than others. Information-processing theory elaborated in Chapter

Two makes clear that the success of project implementation is largely influenced by the way in which information is managed (Guss 1998; Weiser and Morrison 1998).

However, some disadvantages were also found with the centralised approach. For instance, it was evident in the GFM case that the refinement of organisational memory was largely dominated by the core team members and some key programme participants. By comparison, in the decentralised approach employed by BTC, all programme participants had more or less the same significance in refining and reshaping the organisational memory. Hence, this latter approach was more effective in diffusing the new practices into different parts of the organisation, even though it increased the dispersion of organisational memory. On the other hand, the centralised approach was found to be more vulnerable to staff turnover. It is clear from the GFM case that high staff turnover, in particular, in the core team, significantly influenced the continuity of organisational memory refinement. This echoes the findings of the empirical study by Carley (1992), who argues that staff turnover considerably influences the organisation's learning capability due to the reduction of organisational memory.

6.5.3 Issues influencing the organisational memory refining process

From the above discussion about the nature of organisational memory refining, it is clear in the two cases that this process was not only cross-functional, as reflected in the dispersion of organisational memory (Walsh and Ungson 1991), but also on-going. In addition to the importance of trust for open communication (Misztal 1996; Newell and Swan 2000) and social networks for knowledge exchange (Nahapiet and Ghoshal 1998), the findings suggested three major factors that influenced the process of organisational

memory refining: the management of group diversity, and the transformation and embedding of knowledge into practice.

6.5.3.1 Group diversity

As the discussion in Section 6.4 showed, group diversity is crucial not only for stimulating creativity (Cox 1991; Jarratt 1999; McGinnis and Ackelsberg 1983; Tushman and Nadler 1986), but also for enhancing group performance (Fiol 1994; Hurst, Rush and White 1989; Steensma and Tetteroo 2000). The research findings show that diversity, in particular in terms of knowledge and subcultural background, also contributed much to the refining of organisational memory. The diversity of knowledge was revealed particularly in the discussion of the use of external expertise to change existing organisational practices. Additionally, the use of contractors in the GFM case was found to be particularly critical in bringing new knowledge into the organisation. This confirms the argument of Huber (1991), that the enrolment of organisational members serves as a vital mechanism enabling organisations to learn and also renew their collective memories.

However, evidence indicates that it was not the diversity in itself that benefited the process of organisational memory refining. Rather, it was the way in which the diversity was managed and utilised that was decisive. For instance, the two programmes were designed to accommodate differences in ideas and thoughts, in other words to take into account and leverage group diversity, especially during the initial phase of the programmes. On the other hand, it was evident in the two cases that group diversity could often lead to intra- and inter-group conflict and inequality as reflected in the

findings of Linnehan and Konrad (1999). Hence, the awareness of the power distribution between groups is a critical issue when considering the management of group diversity.

Drawing on the concept of organisational learning proposed by Senge (1990), it is clear that leaders play a vital role in creating tension between the current situation and the vision as a means of fostering generative learning. The importance of creating tension also has a close link with the management of group diversity in refining organisational memory. However, the way in which tension emerged in the two cases was found to be different. Often, tension was derived from differences in knowledge and subcultural backgrounds. These forms of diversity could also become boundaries, as shown in Section 6.2. From the accounts in Chapters Four and Five, it is clear that the way in which group diversity and tension were utilised and managed in the two cases was very different. In the GFM case, based on a centralised project management approach, group diversity was minimised to ensure that the GMP would be implemented to the same standards across the globe. On the other hand, in the BTC case, the programme design sought to maximise group diversity not only for the purposes of representativeness but also in order to stimulate new ideas. This reflects the rationale for having cross-functional project teams (Henke, *et al.* 1993; Noble 1999; Ramesh and Tiwana 1999) to accomplish difficult tasks.

Differences in terms of maximising and minimising group diversity in the refining of organisational memory were evident in the two cases. Even though it was clear from the GFM case that minimising group diversity helped to speed up the project life cycle by suppressing different opinions, the impact of diversity on the organisational memory

refining process was also minimised. This was because individual members, intellectually and emotionally, did not perceive the need to redefine their existing practices. This was especially true of those who were less involved in the planning and redesign phases. On the other hand, in the BTC case, the maximising of group diversity helped to stimulate the refinement of organisational memory. At the same time, however, it also gave rise to the problem of overcoming individual resistance to change and dealing with the unbalanced power distributions between participants (Linnehan and Konrad 1999). Thus, group diversity can be beneficial to the refinement of organisational memory, but can also cause problems. This underlines the need to manage group diversity more consciously and strategically (Jarratt 1999) based on the programme design and orientation.

6.5.3.2 Knowledge transformation and embedding knowledge into practice

Another issue that influenced the process of organisational memory refining in the two cases was the embedding of knowledge into practice. The discussion of organisational knowledge and organisational memory in Chapter Two suggests that information provides very little strategic value, unless it is transferred into knowledge (Boisot 1995). Also, it is clear that the importance of knowledge to organisations does not merely lie in the knowledge itself, but in the way in which knowledge is integrated (Grant 1996), created (Nonaka and Takeuchi 1995) and managed (Zack 1999). This mirrors Blackler's (1995) concept of 'knowing', which highlights the importance of the way in which knowledge is utilised. This can be best understood by studying what organisational members do rather than what they know. Hence, it is clear from the above discussion that the refinement of organisational memory is largely influenced by a collection of

continuous and interrelated processes through which information is transferred to knowledge, and knowledge is applied into practice as a means of renewing existing practice.

From the analysis in Chapters Four and Five, it is evident that the processes of transformation information into applicable knowledge, applying knowledge into day-to-day practice, and modifying existing practice with new ones enabled the refining of organisational memory in the two cases. For instance, in the BTC case, when the programme participants were involved in the BPR programme, they had very little understanding of the concept of business process redesign. Through the ongoing processes of information acquisition (Huber 1991) and learning-by-doing (Arrow 1962), the participants were able to interpret and reflect on the information that they acquired in order to enhance their experience and knowledge (Kolb and Fry 1975). Similarly, in the GFM case, most programme participants had very little understanding of the concept of business continuity, but the continuous acquisition of information related to this concept helped to improve their understanding. In both cases, it was only when the programme participants were able to apply what they had learnt to their day-to-day work that existing practices could be renewed. In other words, the utilisation of the newly acquired knowledge enabled the collective refinement of organisational memory.

Linking to the cross-functionality and continuity of organisational memory (Section 6.5.1) and its dispersion (Chapter Two), it is manifest that such knowledge transformation and embedding processes were constantly diffused into various parts of the organisation. For example, in both cases the programme participants from various

organisational units were responsible for transferring what they had learnt into their own units. Thus, the refinement of organisational memory became a collective activity rather than an aggregation of individual changes in working practices. Evidence from the analysis also suggests that these knowledge transformation and embedding processes further increased the dispersion of organisational memory. This is in accordance with the conclusions of studies of knowledge flow in knowledge-intensive firms (Starbuck 1992), where knowledge flow enables knowledge workers to renew their practices collectively and continuously.

6.5.4 Summary of the organisational memory refining process

Starting with the nature of the organisational memory refining process, the above discussion has suggested that this process exhibits not only cross-functionality but also the continuity of activities which underpin the programme. In particular, in the cross-functional project team context, this explains why organisational memory continuously goes through the processes of integration and differentiation. The ongoing process of cross-functional knowledge integration and differentiation further enabled the refinement of organisational memory. It is also clear from the above discussion that the tactics used for programme design and management largely influenced the process of organisational memory refining. As we have seen, the use of external expertise -- and contractors in the GFM case -- served as a vital stimulant of organisational memory refining, as well as organisational-knowledge creation (Matusik and Hills 1998) and organisational learning (Huber 1991). However, it is also evident that when contractors and external consultancy teams leave the organisation, the problem of knowledge loss can arise. This is particularly apparent in cross-functional programme teams where

contractors are the key players for programme design and implementation. Hence, it is vital to deploy mechanisms to reduce the impact of knowledge loss. Documentation was commonly used for this purpose in the two cases, in addition to other mechanisms such as team learning (Senge 1990). Even though the usefulness of documentation was rather limited and largely influenced by the programme orientation, it could still influence the organisational memory refining process. In particular, it was found that the knowledge-oriented documentation approach was more likely to enable fundamental changes in organisational routines and practices in comparison to the information-oriented approach.

Group diversity was also found to be a vital issue which influenced the process of organisational memory refining. Even though the disadvantages of group diversity were evident, it helped to create sufficient tension through knowledge and subcultural differences to enhance the refinement of organisational memory. Knowledge transformation and the embedding of knowledge into organisational practices were also critical issues related to the process of organisational memory refining. Indeed, it was through the processes of transforming information into knowledge and applying knowledge to practice that organisational memory was refined. The sharing of new practices across various organisational units enabled organisational memory refining to become a collective activity rather than a mere aggregation of individual actions to acquire or create new knowledge and experience. It is also clear from the above discussion that the process of organisational memory refining was greatly influenced by the other three knowledge integration processes elaborated above. The following section outlines the interrelationships between the four processes.

6.6 The Interrelationships between the Four Processes

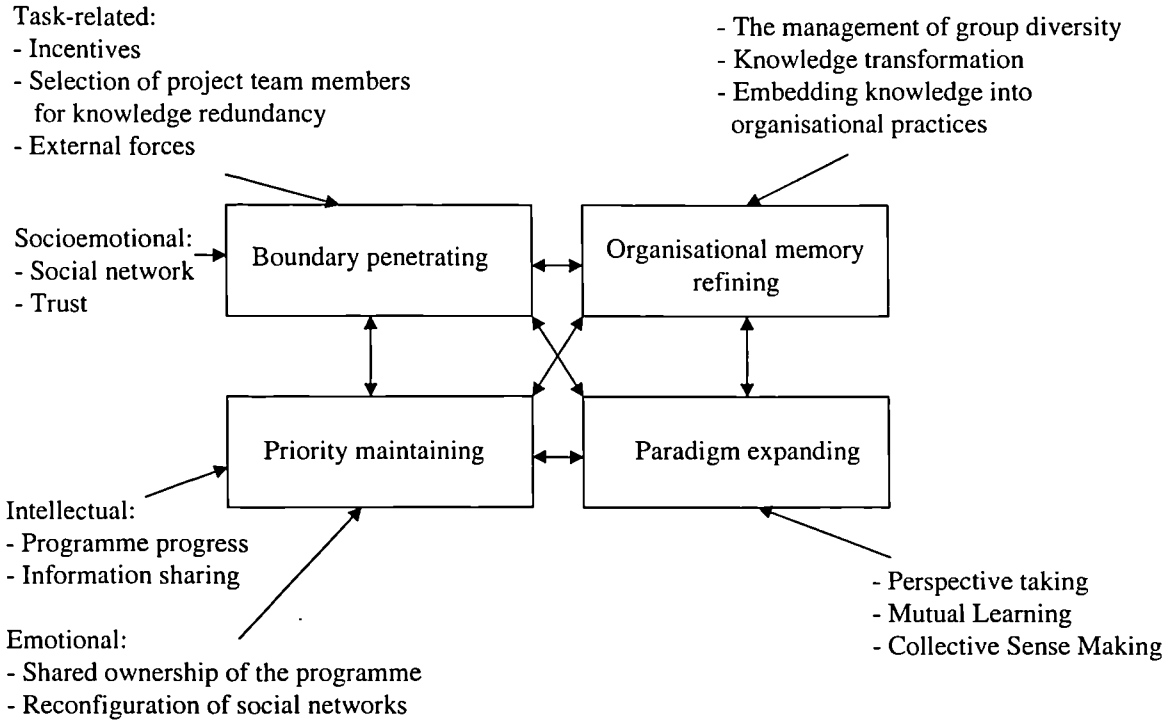
Knowledge integration starts with the boundary penetrating process, which then leads to the processes of priority maintaining, paradigm expanding, and eventually organisational memory refining. However, this does not mean that knowledge integration processes within cross-functional project teams are linear. Rather, they are interwoven and take place at various phases of the programme, as shown in Figure 6.2.

It was found that in the two cases, aligning the programme participants and the programme stakeholders intellectually and emotionally helped the core team to penetrate three different types of boundary. Also, all three types of boundary were not only task-related, but also socio-emotionally, oriented (Beene and Sheats 1948). This points to a link between the penetration of various types of boundary and the maintenance of programme priority through the achievement of intellectual and emotional buy-in. The latter was found in both cases to greatly influence perspective taking (Boland and Tenkasi 1995; Sessa 1996) and to facilitate the management of group diversity. Group diversity is certainly one of the critical issues for creativity (Hauser 1998; Tushman and Nadler 1986; Wheelwright and Clark 1992), and was found to be the main source of paradigmatic differences in the two cases.

Hence, referring to the boundary penetrating process, it is clear that group diversity was also the source of creating boundaries, in particular functionally specific knowledge and organisational-subcultural boundaries. This shows that the relationship between

boundary penetrating and paradigm expanding is mutually reinforcing and interdependent.

Figure 6.2 Processes of knowledge integration and factors influencing the processes



In terms of the relationships between organisational memory refining and boundary penetrating, it is evident that newly recruited organisational members often encountered more problems in penetrating boundaries than did the more experienced members. The cross-functionality of organisational memory, as reflected in its dispersion (Walsh and Ungson 1991) and in the number of organisational members involved, requires the process of boundary penetrating to enable the refining process. This links to one of the issues in Section 6.5.3, that highlighted the need for knowledge transformation and the embedding of knowledge into organisational practices. From Section 6.5.3, it is clear that before organisational memory can be refined, information needs to be distributed

and transferred to knowledge. Knowledge transferred from information further needs to be applied into practice. Thus, in the two cases, it was manifest that organisational memory could only be refined by penetrating various boundaries, in particular the boundaries created by the reality of different organisational subcultures and the existence of functionally specific knowledge. The importance of priority maintaining in relation to organisational memory refining suggests that the latter process can only continue if it has an adequate resource base. This also points to the importance of priority maintaining as the determinative process influencing the continuity of knowledge integration. Additionally, the need for intellectual and emotional buy-in indicates that the refinement of organisational memory is not merely an intellectual activity that changes existing routines and practices, but is also an emotional activity that reconfigures the landscape of social networks within the organisation.

6.7 Summary from the Perspective of Organisational Knowledge and the Concept of Knowing

6.7.1 The perspective of organisational knowledge

The processes of knowledge integration elaborated in the present chapter reveals how programme participants integrate knowledge through planning, designing and implementing phases of the programme. Each process is distinctive and is influenced by a range of issues. At the same time, the four processes are interconnected and mutually reinforcing, and collectively contribute to the renewal of organisational knowledge. The process of boundary penetrating is vital, because shared understanding relies on the penetration of boundaries created by functionally specific knowledge. The concept of

intellectual and emotional buy-in underpinning the priority maintaining process shows that the integration of organisational knowledge is triggered not only by the needs perceived by the programme participants, but also by the establishment of emotional attachment (Lembke and Wilson 1998) between them. Moreover, paradigmatic differences, as the representation of group diversity, are found to be a critical element in the processes of cross-functional knowledge integration. As illustrated earlier, group diversity can have a positive influence on the process of paradigm expanding, because it is a vital source of creativity (Hauser 1998; Tushman and Nadler 1986). On the other hand, it can also lead to group inequality (Lineman and Konrad 1999), in particular where power distribution is unbalanced between programme participants (Brass and Burkhardt 1993; Feldman 1999).

The process of organisational memory refining is also critical for the renewal of organisational knowledge. As we have seen, information can only provide strategic significance when it is transferred to knowledge. Knowledge can only be meaningful to organisational members when it is applied and embedded into organisational routines and practices. The refinement of organisational memory contributes to the renewal of organisational knowledge by discarding, redefining and combining practices in which knowledge is embedded. This reflects not only the importance of unlearning (Hedberg 1982; Nystrom and Starbuck 1984), but also the role of unlearning plays in the process of knowledge integration. The above discussion focuses primarily in the issue of how organisational knowledge can be renewed through the integration of functionally specific and dispersed knowledge. The following section highlights how the concept of knowing is related to the processes of cross-functional knowledge integration.

6.7.2 The concept of knowing and cross-functional knowledge integration

'Knowing' (Blackler 1995) is one of the fundamental concepts underlying this study. The five types of knowing elaborated in Chapter Two show that what organisational members do can be analysed and understood from five perspectives: knowing-who, knowing-what, knowing-how, knowing-why and knowing-where. It is also clear from Chapter Two that the concept of knowing-when is less articulated in the current literature. Referring to the present chapter, it is clear that each process of knowledge integration fulfils some specific needs for each type of knowing. For instance, in the two cases, the concept of knowing-what was expressed in the need for collective learning, through which programme participants were able to acquire knowledge by doing and involving (Arrow 1962; Lave and Wenger 1991). However, it is also clear that in order to acquire knowledge that was embedded within different organisational units or possessed by other members, programme participants had to penetrate various types of boundary. This highlights not only the task-related dimension of knowing-what, as reflected in the process of knowledge acquisition, but also the socio-emotional dimension of penetrating mental boundaries.

The concept of knowing-where was found across the two cases, because of the dispersion of organisational memory and knowledge, as well as the geographical dispersion of organisational units. This again suggests the need for a boundary penetrating process as a means of integrating knowledge which is often concealed behind departmental boundaries. In terms of knowing-who, the process of priority maintaining was critically important, in particular to achieve emotional buy-in through

the reconfiguration of social networks. This point is reflected in the study of Burt (1992), who suggests that a social network derived from the interpersonal relationships between network members enables the members to access information which is sometimes inaccessible to non-network members.

According to the illustration of knowing-why in Chapter Two, it is clear that the concept refers to the process through which organisational members make sense of what they do. This meaning is also captured in the notion of collective-sense making, according to which organisational members collectively create a social reality that then becomes the organisational reality (Boyce 1995). By taking into account individuals' differences in terms of knowledge and subcultural backgrounds, it is clear that the process of knowing-why or collective-sense making is enabled by the exposure of different paradigms, and more importantly by creating overlaps between paradigms, as elaborated in the process of paradigm expanding. As the discussion of knowing-how in Chapter Two shows, the process of knowing-how highlights the utilisation of procedural knowledge (Cohen and Bacdayan 1994) to carry out activities that often require the tacit, embodied knowledge possessed by organisational members (Blackler 1995; Collins 1993). Changes in organisational routines and practices, such as the process of organisational memory refining, suggest that organisational members collectively alter the procedural knowledge embodied within their activities. In other words, the renewal of knowing-how requires the process of organisational memory refining to trigger the development of new procedural knowledge.

Clearly, this study does not directly provide insightful stories to elaborate how organisations prioritise their knowledge-related activities, thereby filling a major gap in the current literature on the subject of knowing-when. However, the process of priority maintaining does help to explain the nature of knowing-when. As Section 6.3 shows, the way in which an organisation prioritises and allocates resources for knowledge-related activities cannot be considered as merely an exercise based on an objective calculation of potential pros and cons. Rather, it is equally important to take into account the way in which the prioritisation of knowledge-related activities is influenced by the ongoing social interaction between organisational members. This underlines the importance of social networks in the process of priority maintenance, where network members benefit from a better timing to gain access to resources than those who are not part of the social networks (Burt 1992; Nahapiet and Ghoshal 1998).

The above discussion helps us to understand how the processes of knowledge integration contribute to the renewal of organisational knowledge, as well as how knowledge-integration processes are interwoven with various types of knowing that are crucial in explaining and understanding knowledge-related activities within the context of cross-functional programme teams. It must be recognised, however, that there are inevitably some limitations of the present study. In Chapter Seven we will offer a more detailed account of the theoretical and managerial contributions of this study, as well as acknowledging the limitations of the study and briefly indicating some possible directions for further research.

Chapter Seven: Conclusion

7.1 Introduction

This study has achieved its stated aim by filling the identified research gap with a theory of cross-functional knowledge integration processes. Findings presented in this study elaborate not only four interrelated knowledge integration processes within the context of cross-functional project teams, but also various issues which influence the dynamics of these processes within broader organisational contexts.

Reflecting on previous discussions, Chapter Two critically examined the current literature focusing mainly on the areas of organisational knowledge, knowledge-related activities and the social construction perspective. As already elaborated, organisational knowledge, organisational memory and paradigms are not only dispersed across various parts of an organisation (e.g. Tsoukas 1994; Walsh and Ungson 1991), but are also constructed through the social interaction of organisational members (e.g. Wenger 2000). The distinctiveness of functionally specific knowledge which is often embedded within specific parts of the organisation (Nonaka and Konno 1998) further indicated the need for taking into account the influence of knowledge diversity in examining the process of cross-functional knowledge integration. The review of current literature indicated that although the concept of knowledge integration has been implied in many previous studies, there are few which have tried to explore knowledge integration processes per se. Despite this lack of coherent theoretical development, previous studies have provided some valuable insights which contribute to our understanding of

processes and dynamics of cross-functional knowledge integration. In particular, in Chapter Two previous accounts that have studied the concept of knowledge integration from a number of perspectives including social, strategic, cognitive (paradigmatic) and organisational memory perspectives were explored. The review, however, highlighted the fact that there are few studies that provide a holistic account to depict the processes and dynamics of cross-functional knowledge integration.

Inspired by such a salient theoretical gap, two cases were conducted in NatWest GFM and BTC as a means of exploring how knowledge was integrated within the cross-functional project team context and identifying issues that influenced the processes of knowledge integration. Data collected from interviews, on-site observation and documentation was then analysed based on the notion of open, axial and selective coding (Strauss and Corbin 1990).

During the axial coding, the four interrelated themes that emerged from the case study of the BTC Business Process Redesign Programme were penetrating departmental boundaries, sustaining the project priority, changing individual beliefs, and modifying existing organisational routines and practices. Four themes that were generated from the GFM case were bridging the knowledge gap between programme participants, overcoming communication barriers, sustaining the programme priority and reconfiguring existing organisational practices. Based on selective coding, themes generated from each case were compared and synthesised into four interrelated knowledge integration processes, namely boundary penetrating, priority maintaining, paradigm expanding and organisational memory, as presented in Chapter Six. To sum

up, this study suggests that cross-functional knowledge integration is not merely an intellectual activity triggered by individuals' knowledge differences, but also an emotional activity enabled by the social interaction of organisational members. Understanding the dynamics of cross-functional knowledge integration can not solely depend on analysing either intellectual or emotional aspects. Instead, there is a need to take a holistic approach and appreciate the interplay between these two aspects.

In addition to the present section, the rest of the Conclusion Chapter is structured into two sections. Section 7.2 illustrates some limitations of this study on the examination of cross-functional knowledge integration and proposes a number of suggestions for future research directions. Section 7.3 summarises the theoretical, managerial and methodological contributions and implications made by this thesis.

7.2 Limitations and Future Research

Despite the significant contribution at theoretical, methodological and managerial levels that will be elaborated later, the thesis does obviously have some limitations that call for further research effort. To sum up, this section outlines the limitations of the study on the investigation of cross-functional knowledge integration and makes a number of suggestions for future research directions.

First of all, in terms of the way in which the current literature is reviewed, it is clear that this study emphasised primarily the areas of organisational knowledge and knowledge-related activities. Despite the fact that issues such as virtual teamwork, group dynamics,

trust and social networks have been discussed in the thesis, the review of the current literature related to these issues was less than extensive. Furthermore, even though contributions of the IS research to our understanding of organisational knowledge and knowledge-related activities are evident (see for example, Lee 1994; Markus 1983 and Yoon, Guimaraes and O'Neal 1995), the more general literature on the management of information systems was not incorporated into the study. This limitation can be explained by the focus of this study which aims to make contributions in the area of cross-functional knowledge integration, rather than virtual teamwork, management of information systems or trust per se. However, such limitation represents future research opportunities by further exploring the concept of cross-functional knowledge integration from different aspects.

Secondly, with the objective of exploring the dynamics of knowledge integration within the context of cross-functional programmes, this study was limited in having to observe programmes during the implementation stage rather than over the whole life cycle. As a result, evidence relating to the planing and redesign stages is largely retrospective. Further research that aims to examine knowledge-related activities within the context of cross-functional project teams could certainly benefit from a more complete picture, if a more comprehensive longitudinal approach is taken. In particular, the employment of a longitudinal approach will enable future research to observe changes in the social network landscape within a broader organisational context.

Thirdly, even though this study pointed out two critical dimensions of knowledge integration, intellectual and emotional, it did not explore in depth how both dimensions

can influence the efficiency and quality of knowledge integration. The notion of knowledge integration can explain virtually every organisation's activity (Grant 1996; Lawrence and Lorsch 1967), the limitation faced by the present research indicates that more research efforts are needed to anticipate the issue of efficiency and quality as a means of understanding an organisation's competitiveness. Clearly, future research that aims to tackle such issues, as well as the relationship between other knowledge-related activities and organisational competitiveness would need to incorporate the intellectual and emotional dimensions. More importantly, future research efforts should take into account the interplay of these two dimensions, rather than treat them as two separated concerns.

Fourthly, despite the fact that the present study has collected data related to the programme participants and the stakeholders, this study did not extend the scope of data collection further to investigate how people external to the organisation participated and influenced the processes of knowledge integration. For instance, suppliers of BTC were also involved heavily in part of the BPR programme, in particular in the Sales Plan Project. In the GFM case, personnel from the NatWest Group, other subsidiaries, as well as external service providers such as BT were likewise involved in the GMP. Such limitations call for more studies that are able to provide an empirical account based on the evidence of inter-organisational knowledge integration.

Fifthly, from the critical examination of the current literature on 'communities of practice' (Brown and Duguid 1991; Orr 1990; Wenger and Snyder 2000), it is clear that research related to such a concept is limited primarily to a single community. Although

the importance of examining how different 'communities of practice' interact was proposed in Chapter Two, because of accessibility the present research was not able to collect sufficient data to answer one of the research questions listed in Section 2.5.3.2. The research question proposed is "how does a community learn from other communities, and how does collective learning take place among communities?" Communities of practice are vital for organisational learning (Brown and Duguid 1991; Lave and Wenger 1991), but it is evident that they are equally vital for cross-functional knowledge integration. The limitation encountered by the present research suggests that future research should move beyond the conventional approach of studying one single community and explore how knowledge-related activities, in particular knowledge integration, take place between communities.

Finally, despite the fact that this study elaborates the nature of knowing-when from the aspect of resource allocation, the processes through which organisations prioritise their knowledge-related activities remain unexplored. This clearly requires more research to examine how these decisions are made, and what issues influence such decision-making processes. Concepts such as the retrieval of organisational memory (Walsh and Ungson 1991) and organisational frame of reference (Shrivastava and Schneider 1984) can provide a useful foundation in anticipating such issues. Furthermore, a comprehensive and holistic account of knowledge-related activities will rely on more empirical studies that take into account the six different types of knowing.

7.3 Contributions and Implications

In seeking to explore one of the currently underdeveloped areas of knowledge-related activities and to fulfil the salient theoretical gaps in the area of knowledge integration, a grounded theory that depicts the processes of cross-functional knowledge integration was proposed. Building on a critical examination and analysis of the chosen phenomena, this thesis provided an empirical account that is explorative in design and synergistic in nature. By placing emphasis primarily on the processes instead of purely on the outcomes of cross-functional knowledge integration, insights generated by this study enhance our understanding by providing a more comprehensive picture of the chosen area. However, the contribution made by this study is not limited to a theoretical one. The contribution also has its methodological and managerial importance. The following sections highlight the main contributions of this study based on these three levels, namely theoretical, managerial and methodological.

7.3.1 Theoretical contributions and implications

7.3.1.1 A synergistic account of cross-functional knowledge integration

Stemming from the synergistic nature of this study, one of the major contributions is to provide an integrative and novel account of cross-functional knowledge integration. Four interrelated knowledge integration processes were proposed that not only provide a critical comparison with current empirical findings, but also synthesise numerous areas that have until now been examined in isolation.

The discussion of the boundary-penetrating process identified various types of boundary based on two distinctive dimensions within three different organisational contexts. Additionally, two sets of issues which influenced the process of boundary penetrating were identified. From the task-related aspect, the use of incentives, the selection of programme team members to create knowledge redundancy, as well as external forces were all found to be vital. From the socio-emotional aspect, the use of social networks and the development of trust were found to be paramount. The discussion of the boundary penetrating process that also demonstrated how these boundaries evolve is vitally important to cross-functional knowledge integration. In comparison with the current literature, it is clear that some of the project management literature (e.g. Pinto and Pinto 1990; Turner and Keegan 1999) points out the importance of cross-functional knowledge sharing, but fails to problematise this process. By contrast, the concept of boundary penetrating suggests the incompleteness and inadequacies of perceiving knowledge sharing as merely a psychological issue determined by an individual's willingness (e.g. Combs 1993; Walz, *et al.* 1993). Instead, knowledge sharing can be inhibited by one or more of the boundaries identified by this study, even when an individual is willing to share his/her knowledge. Hence, knowledge sharing is a collective activity which requires the initial process of boundary penetrating to ensure that physical distance can be overcome, subcultural differences can be managed and a shared understanding can be established.

Furthermore, based on resource dependency theory (Pfeffer and Salancik 1978), being able to access strategically important resources can be critical to an organisation's survival. The capability to absorb and utilise such resources is equally critical,

particularly when we acknowledge that knowledge is socially constructed, context dependent and functionally specific. Furthermore, the discussion of the boundary-penetrating process pinpointed that it is not only tacit knowledge that prohibits individuals from understanding. Explicit knowledge can also create a boundary because of poor accessibility, a lack of knowledge redundancy (Nonaka 1990) and common knowledge (Demsetz 1991), as well as functional specificity.

While the concept of boundary penetrating clearly overlaps with the well-developed concept of boundary spanning (e.g. Katz and Tushman 1983; Schwab 1985; Tushman and Scanlan 1981; Yan and Louis 1999), there are also some important differences. In particular, in comparison with the concept of boundary spanning that primarily focuses on task-related issues, the process of boundary penetrating suggests also the importance of the socio-emotional aspect. Moreover, the concept of boundary penetrating also emphasises the need to take into account the interplay between the task-related and socio-emotional aspects.

Derived from the notion of the cost related to the production of knowledge (Demsetz 1991), the discussion of resources that are vital for energising knowledge-related activities showed that such issues have often been neglected by previous studies. The concept of priority maintaining reveals that the way in which resources are allocated is not merely an objective calculation of the potential pros and cons that a programme can create (e.g. Capron, *et al.* 1998; Mamaghani 1999). Resource allocation is also an ongoing socialisation process in which decisions to allocate resources are largely influenced by interpersonal relationships developed between organisational members. In

comparison with some of the project management literature (e.g. Cooper 1988; Lemaitre and Stenier 1988) that emphasises the importance of securing resources primarily at the planning stage, this study suggests the continuous need for maintaining project priority at every stage of the project life cycle.

As elaborated, intellectual buy-in is influenced by the progress of the programme both physically and symbolically, as well as by information sharing between programme participants and stakeholders at various managerial levels. On the other hand, emotional buy-in is influenced by sharing ownership between the programme participants and through the reconfiguration of social networks within the organisation. The introduction of intellectual and emotional buy-ins demonstrated that knowledge-related activities could not be perceived as merely being triggered by the content of knowledge. Also, it is vital to take into account the emotional element that is developed through participation (Lave and Wenger 1991) and sustained by issues such as trust (Newell and Swan 2000) and social networks (Nahapiet and Ghoshal 1998).

The discussion of paradigm within the organisational context elaborates its nature as being practice-based, cross-departmental, socially constructed, and context dependent. This reflects the similarities between paradigm and knowledge within the context of 'community of practice' (Brown and Duguid 1991), as reviewed in Chapter Two. The nature of paradigm and the dynamic nature of a paradigm expanding process also indicate the inappropriateness of the term "paradigm shifting" suggested by scholars (e.g. Chia 1996) because of the difficulty of actually changing paradigms which can be very 'sticky'. Theoretically overlapping with some of the group dynamics literature,

paradigmatic differences serve as a vital mechanism for stimulating creativity as reflected in the discussion of group diversity (Hauser 1998; Tushman and Nedler 1986). The way in which paradigmatic differences are solved mirrors the mechanisms by which group diversity is managed.

Two critical issues that influence the process of paradigm expanding are perspective taking (Boland and Tenkasi 1995; Sessa 1996) and mutual learning (March 1991). The evidence from the cases suggests that perspective taking is not merely an intellectual activity as suggested by Boland and Tenkasi (1995), but also an emotional one in which perspective taking can be considered as a socialisation process, influenced by the interpersonal relationships between programme participants. On the other hand, findings generated by this study mirror the work of March (1991) who indicates that mutual learning between organisational members enables the renewal of organisations, as well as the socialisation of newly recruited organisational members. However, this study has extended March's work by elaborating not only the relationships between mutual learning and cross-functional knowledge integration, but also the need for an individual to expand his/her paradigm as a means of enabling mutual learning to take place.

Similar to the concept of collective sense-making (Boyce 1995), the paradigm expanding process addresses the need for building shared meanings and paradigmatic redundancy amongst the programme participants. However, the evidence from the cases shows that the paradigm expanding process also differs from the concept of collective sense-making. In particular, the discussion of the paradigm expanding process emphasises the diversity of knowledge background between programme participants and

the development of an individual's knowledge at every stage of the programme, an issue which is neglected in Boyce's study.

Comparing the concept of 'collective mind' (Weick and Roberts 1993) with the process of paradigm expanding, theoretical similarities lie in the need for distributed cognition between participants to enable and facilitate collective activities. One of the major differences is that based on Weick and Roberts' investigation, a collective mind is developed through continuously repeated activities. In the context of cross-functional project teams, a collective mind cannot be nurtured only through repetition, because the participants are constantly facing different tasks and problems. Additionally, the concept of paradigm expanding takes into account the issue of power distribution within various organisational contexts, while such an issue is neglected in Weick and Robert's study.

Organisational memory, as shown in Chapter Two, is a research area that is fully developed in concept but saliently short in empirical evidence (Ackerman and Halverson 2000). This thesis not only provides empirical evidence to enhance overall understanding of this concept, but also explores the process through which organisational memory is refined as the programme proceeds. Instead of regarding organisational memory as merely a collection of information and history (e.g. Anand, *et al.* 1998; Hackbarth and Grover 1999), this study unveils its dynamic nature and suggests that organisational memory is constantly refined through the social interaction of organisational members. This further pinpoints the need for taking into account the socially constructed nature of organisational memory when investigating such a concept. The notion of organisational memory refining outlined in Section 6.5 illustrated how

organisational routines and practices are gradually surfaced, challenged and modified through various stages of the cross-functional programme. The nature of cross-functionality suggests that organisational memory refining is a process which integrates the knowledge diversity of the different organisational units, as reflected in the dispersion of organisational memory (Moorman and Miner 1997; Walsh and Ungson 1991). The memory refining process echoes the notion of the loosely coupled system (Orton and Weick 1990) in which the distinctiveness of functionally specific knowledge is constantly integrated to create common knowledge (Demsetz 1991). On the other hand, the need for common knowledge gradually increases along with the development of functionally specific knowledge. In other words, the distinctiveness of functionally specific knowledge can be considered as a dynamic concept that is continuously changing overtime.

This study suggests that organisational memory is refined based on three interconnected processes, which are transforming information to knowledge, applying knowledge to activities and embedding such action-based knowledge into organisational routines and practices. In addition to the transformation of knowledge and the embedding of knowledge into organisational practice, the management of group diversity is another critical issue that influences the process of organisational memory refining. As elaborated earlier, group diversity can be developed through employing external expertise or contractors, as well as through the involvement of programme participants from various organisational units.

Another vital theoretical contribution of this study is to elaborate the dynamic interrelationships between those four processes. Findings generated by this study suggest that the four processes of cross-functional knowledge integration are not only highly interconnected, but also mutually reinforcing. As shown in Figure 6.2, this study emphasises the importance of aligning programme participants and stakeholders intellectually and emotionally as a means of penetrating various types of boundary, as well as maintaining programme priority. The need for an intellectual and emotional buy-in as reflected in the priority maintaining process also underlies the fact that the process of paradigm expanding cannot be perceived as merely an intellectual activity. Instead, it is also vital to take into account the emotional element derived from social networks. Group diversity as one of the key elements in cross-functional knowledge integration is evident as a source of intergoup conflict and boundary creation. But on the other hand, group diversity as often represented in paradigmatic differences, is also an effective means of stimulating creativity and refining organisational memory. The importance of transforming information into knowledge and applying knowledge in day-to-day activities was found to be crucial for the refinement of organisational memory. Clearly, this requires the penetration of boundaries, in particular the type created by the existence of functionally specific knowledge. The penetration of boundaries, the expansion of paradigms, and the refinement of organisation memory were found to be three ongoing processes that portrayed the dynamics of cross-functional knowledge integration. However, the continuity of these processes is largely determined by the availability of resources. This further explains the importance of priority maintaining in relation to the other three knowledge integration processes.

7.3.1.2 Knowledge integration in the context of cross-functional teams

Although cross-functional project teams have been commonly used to solve novel problems (Denison, *et al.* 1996; Hauptman and Hirji 1999) or stimulate knowledge creation (Nonaka and Takeuchi 1995; Walz, *et al.* 1993), ironically very little is understood about how cross-functional project teams integrate the diverse sources of knowledge. Based on the empirical evidence and the development of the cross-functional knowledge integration process theory, this study has been able to enhance understanding in the areas of organisational knowledge and knowledge-related activities by adding a group dimension into the analysis, in particular in relation to groups which are geographically dispersed.

By exploring the concept of 'community of practice' within the virtual setting, this study has extended Brown and Duguid (1991) and Wenger and Snyder's (2000) notion of 'community of practice' by providing empirical evidence on how geographically dispersed community members integrate knowledge. Clearly, even though the community of practice can be organised on a cross-functional programme team basis, the evolution of a 'virtual community' is not necessarily bounded by the team boundary. Instead, the virtual community derives from social networks where there are intensive social interactions between dispersed members. Comparing cross-functional knowledge integration with the concept of situated learning (Lave and Wenger 1991), this study has shown that the dynamics of 'peripheral legitimate participation' are different within the cross-functional programme team. This is because during the initial stage of the programme, all programme participants are new to the learning community and there is very little difference between participants in terms of programme experience. Moreover,

despite the fact that the core team members may have comparatively more experience about the subject than the other programme participants, it is not the participants who obtain recognition through participation and learning. Instead, it is the core team members who acquire support and resources from the participants through the transfer of skills at the intellectual level and the formation of alignment at the emotional level. It was also demonstrated how a new subculture that is unique to the learning community evolves through the social interaction and collaboration between the participants. The need for social interaction and the socially constructed nature of knowledge integration is one of the key contributions of this thesis.

7.3.1.3 Social construction perspective of knowledge integration

Despite the fact that the social construction perspective (Berger and Luckmann 1967) has been widely adopted by various studies, such as studies of ICT (Fulk 1993; Sahay and Palit 1994), strategic change (Scarbrough 1996), and organisational learning (Nicolini and Martin 1995), using such a perspective to examine the issue of knowledge integration is limited. This further reflects the third contribution made by this study of employing the social construction perspective to study the phenomenon of cross-functional knowledge integration. This involved examination and evaluation of various theories and ideas derived from the social construction perspective, such as SCOT (McLoughlin 1990; Pinch and Bijker 1987) and actor-network theory (Latour 1987). Clearly, these contributions are not mutually exclusive but reinforce each other. Furthermore, they all share the view that the essence of studying any social process is in the understanding of the dynamics of social interaction. As depicted in Chapter Two, it is clear that the strategic management literature primarily focuses on the outcome and

the value of organisational knowledge, often perceiving knowledge as a set of assets or commodities that can be transferred, utilised, and detached from the context (Hiebeler 1996; Kim and Mauborgne 1999). By taking into account the way in which knowledge is constructed and the social context in which knowledge is embedded, this study has been able to open up the 'black box' of cross-functional knowledge integration. Moreover, based on the social construction perspective, this study highlights the need to take into account the interplay between intellectual and emotional elements underlying knowledge-related activities.

The process of boundary penetrating, for instance, demonstrates that various types of boundaries exist within organisations and these are not only created by formal departmental boundaries, but are also influenced by the landscape of social networks. Based on the social construction perspective, it is clear that the discussion of boundary penetrating processes can be applied to other knowledge-related activities, such as knowledge sharing and knowledge transfer. The process of priority maintaining shows that the study of resource allocation, which is often regarded as an activity based on objective measurement, also needs to take into account the emotional elements of the interpersonal relationships between organisational members. This further illustrates that understanding how organisations prioritise their knowledge-related activities needs to examine two interrelated processes, namely intellectual and emotional buy-ins.

The appropriateness of adopting the social construction perspective to examine cross-functional knowledge integration is also reinforced by the process of paradigm expanding. Paradigm with its distinctive nature as practice-based, cross-departmental,

socially constructed and context dependent demonstrates that managing paradigmatic differences is an intellectual as well as a social activity that underlies virtually every stage of the cross-functional programme. Derived from the social construction perspective, the process of paradigm expanding can be further applied to the study of group decision making, as well as cross-functional collaboration. Finally, the process of organisational memory refining demonstrates that organisational routines and practices are altered through transforming information into knowledge and applying and embedding knowledge into day-to-day activities. Based on the social construction perspective of organisational knowledge, it is evident that the process of organisational memory refining can be applied to other knowledge-related activities, in particular collective learning and unlearning.

7.3.2 Managerial contributions and implications

In addition to the theoretical and methodological significance, this study has its managerial contribution and implications. Cross-functional project teams are clearly powerful tools, and the diversity of knowledge contributed by various disciplines is beneficial in terms of stimulating new ideas and solving novel problems. However, the management of cross-functional project teams can also be problematic and teamwork does not always work as expected (Hackman 1990). This reflects the work of Henke, Krachenberg and Lyons (1993) who argue that a cross-functional project team is usually a poorly implemented 'good concept'. This thesis has suggested several practical guidelines from three distinctive but interconnected aspects, namely the management of cross-functional knowledge integration, the development of virtual teamwork and project management.

7.3.2.1 The management of cross-functional knowledge integration activities

The analysis presented in Chapter Six made it clear that group diversity is a vital source of creativity, but on the other hand, that diversity can also create intergroup conflict and inequality. Hence, the effective management of cross-functional knowledge integration activities lies in leveraging such diversity. Evidence provided by this thesis suggests that group diversity can only be leveraged when various boundaries are penetrated and paradigmatic differences are solved. Clearly, to penetrate boundaries and to ensure the expansion of individual paradigms, the development of mechanisms, such as the use of incentives, building trust, fostering social networks, and encouraging mutual learning and perspective taking, are vital. Furthermore, it is essential to recognise that cross-functional knowledge integration is not merely an intellectual activity but also an emotional one. Hence, ensuring intellectual and emotional buy-ins is one of the most critical steps triggering successful cross-functional knowledge integration. On the other hand, knowledge integration like any other knowledge-related activity requires resources. Thus, it is vital to ensure that the required resources are available to sustain the continuity of cross-functional knowledge integration processes.

7.3.2.2 The development of virtual teamwork

Drawing upon the previous discussion, it is evident that virtual teamwork can often be more difficult to develop than that in a conventional team setting. Even though it is clear from the two cases that the employment of a virtual programme team is often inevitable, evidence suggests that its disadvantages can be minimised by ensuring intensive communication and social interaction. Also, it is vital to acknowledge that ICT is a tool

rather than a solution for virtual teamwork. On the other hand, while it is evident that the use of ICT does help to overcome the constraints of physical distance and time differences, it does not necessarily help to overcome subcultural boundaries and mental barriers. Hence, it is paramount to ensure that team members are willing to devote extra efforts to communication and teambuilding.

7.3.2.3 Project management

Lessons learnt from the two cases suggest that management should take into account the issue of knowledge redundancy (Nonaka 1990) during the selection of programme participants, in particular the core team members. Even though it is not always possible to find all potential candidates with similar knowledge backgrounds, it is vital to encourage intensive socialisation and mutual learning between programme participants to ensure that knowledge redundancy can be gradually developed during the early stage of the programme. Secondly, it is important to assess the nature of the programme to consider whether a standard implementation procedure should be initiated, in particular for programmes which have participants in various geographically dispersed locations. Such decisions should also take into account the issue of whether the management of programme related knowledge and information should be centralised or decentralised. As indicated earlier, a centralised approach enhances the efficiency of information sharing, but will very likely reduce the needs for social interaction between the geographically dispersed participants. On the other hand, a decentralised approach helps to stimulate knowledge sharing within social networks, but can delay the progress of the programme. Additionally, it is vital to ensure that the programme gains sufficient

resources and remains a priority throughout its life cycle, in particular for those programmes which have relatively long life spans.

Finally, the experience gained from the BP Amoco study suggests the importance of developing learning tools that are able to enhance continuous learning at various levels, including team, group and organisational. For instance, one of the learning tools used in BP, the after action review, was systematically used to ensure that after each action, participants were gathered together to share what they have learnt during the action. Clearly, this does not suggest that the development of tools per se can be a solution to enhance continuous collective learning. Evidence abstracted from the BP case also suggests the need to develop a common IT infrastructure, foster an open organisational culture, and develop members' abilities to use those learning tools.

7.3.3 Methodological contribution and implications

The four knowledge integration processes identified in this study provide more than just a theoretical contribution. However, they can also be applied to explain the methodological contribution and implications of this thesis from four distinctive but interrelated aspects. This study suggests that the processes of knowledge integration provide a set of useful guidelines which can be considered when conducting an empirical study, in particular before and during the data collection process for doing case studies. Reflecting on the previous accounts related to research methodology, it is clear that emphasis is typically placed upon how research can be conducted and how data can be analysed (e.g. Miles and Huberman 1994; Yin 1984). There are relatively few studies that provide clear guidelines on how to overcome various problems faced by

the researcher(s) before and during the data collection process. In particular, it is comparatively rare to see empirical studies stating the problems or failures they faced during their fieldwork, with an exception of how the researcher(s) is overwhelmed by the richness of the collected data (e.g. Kasl, Marsick and Dechant 1997). Furthermore, there are even fewer studies that indicate how the researcher(s) can or should 'market' themselves and their proposals to ensure gaining access to the research sites, in particular for novel researchers. Often, what can be seen in the current literature is a large number of cases with an impressive set of interviewee lists. Clearly, what was missing from these studies is the description of techniques and know-how so that other researchers can benefit in order to understand how to gain access to their planned research sites. The following discussion will highlight some experience gained by this study based on the processes of knowledge integration.

The concept of boundary penetrating portrays various difficulties faced by this study in terms of gaining access to research sites that have cross-functional projects with an organisation wide coverage. This was discussed in Chapter Three where the need for using different penetration strategies for gaining access was described. For instance, a top-down penetration approach was used in negotiating the access to BP Amoco, while the access to NatWest GFM was gained through negotiating with the programme manager. The discussion in Chapter Three also demonstrates that penetrating one boundary does not necessarily mean that valuable data can be collected. There are also boundaries created by the existence of industrially specific knowledge and the differences in organisational culture and academic culture that each researcher needs to penetrate. In particular, in studying knowledge-related activities, it is vital for the

researcher to equip him/herself with some basic industrial knowledge. As explained in Chapter Three, such a 'situated learning process' can become a very powerful mechanism with which to build up trust and develop interpersonal relationships with potential interviewees. It also illustrates the researcher's willingness to learn about the case company's business which can itself become very valuable in terms of achieving emotional buy-in from the research participants.

From the aspect of priority maintaining, it is clear that keeping the research project on the sponsor's agenda can be rather difficult as detailed in Chapter Three. Various events can occur within the research site which can often terminate the research, events that are very often out of the researcher's control. For instance, the research project with Kodak UK was terminated due to the company's redundancy programme and the research project with National Grid was curtailed because of a change in departmental management. However, lessons learnt from the fieldwork suggest that it is vital for the researcher to achieve intellectual and emotional buy-ins. For instance, intellectual buy-in can be achieved through communicating the potential value of the research to the research site. Achieving emotional buy-in, even though the approach varies from case to case, can often be facilitated by building interpersonal relationships with the research participants, such as sending the researched postcards, Easter and Christmas cards.

From the aspect of paradigm expanding, it is crucial for the researcher to understand and take the researched perspective, as proposed in the concept of perspective taking (Boland and Tenkasi 1995; Sessa 1996). On the other hand, mutual learning (March 1991), one of the paradigm expanding mechanisms, was found to be equally vital not

only for the purpose of building knowledge redundancy between the researcher and the researched, but also for facilitating the achievement of intellectual and emotional buy-ins. In other words, ensuring that the researched understand the value of the overall research as well as their contribution is paramount to the research outcome.

Moreover, from the organisational memory refining aspect, it is essential that the researcher can provide the research site with useful and valuable recommendations as a means of improving their existing practices. Despite the fact that providing the research site with recommendations is not the primary objective of the research, inevitably this is often what the research site expects from the researcher. To include this point in the initial meetings with potential research sites was found to be vital for gaining access. It also provides the researcher with a great opportunity to learn how theoretical concepts can be transferred to practice. To sum up, the methodological contribution and implications are beneficial not only for further research within the areas of organisational knowledge and knowledge-related activities, but also for studies which aim to explore and exploit social processes based on the social construction perspective.

In conclusion, this thesis has explored the processes of knowledge integration in cross-functional project teams from a social construction perspective. In looking at these processes, this study has been able to develop a theory of knowledge integration in cross-functional project teams which both builds on and develops from previous theory in this area. In addition to this theoretical contribution, this study has been able to offer some practical suggestions for improving processes of cross-functional knowledge integration in organisational settings. Finally, reflecting on the personal experience of

conducting this research and using the theory of knowledge integration that has been developed here, the study has been able to offer some methodological insights that can be useful for future researchers especially those in the early stages of their research career.

Reference List

Ackerman, M. and Halverson, C. (2000). "Reexamining organizational memory." Communications of the ACM, 43(1), 59-64.

Agar, M. (1980). The professional stranger: An informal introduction to ethnography, Academic Press, New York.

Agarwal, N. and Singh, P. (1998). "Organizational rewards for a changing workplace: An examination of theory and practice." International Journal of Technology Management, 16(3), 225-238.

Allcorn, S. (1995). "Understanding organizational culture as the quality of workplace subjectivity." Human Relations, 48(1), 73-96.

Alpander, G. (1991). "Developing managers' ability to empower employees." The Journal of Management Development, 10(3), 13-24.

Altheide, D. and Johnson, J. (1997). "Ethnography and justice." Context & method in qualitative research, G. Miller and R. Dingwall, eds., Sage, London.

Alvesson, M. and Sköldberg, K. (2000). Reflexive methodology: New Vistas for qualitative research, Sage, London.

Anand, V., Manz, C., and Glick, W. (1998). "An organizational memory approach to information management." Academy of Management Review, 23(4), 796-809.

Anderson, I., Borum, F., Kristensen, P., and Karnøe (1995). On the art of doing field studies: An experience-based research methodology, Handelshojskolens Forlag Distribution, Munksgaard.

Argote, L. (1982). "Input uncertainty and organisational coordination in hospital emergency units." Administrative Science Quarterly, 27(3), 420-434.

Argote, L., Beckman, S. and Epple, D. (1990). "The persistence and transfer of learning in industrial setting." Management Science, 36(2), 140-154.

Argyris, C. and Schön, D. (1978). Organisational learning, a theory of action perspective, Assison-Wesley, London.

Arrow, K. (1962). "The economic implications of learning by doing." Review of Economic Studies, 29(2), 166-170.

Athanassiou, N. and Nigh, D. (1999). "The impact of US company internationalization on top management team advice networks: A tacit knowledge perspective." Strategic Management Journal, 20(1), 83-92.

Attewell, P. (1996). "Technology diffusion and organizational learning: The case of business computing." Organizational learning, M. Cohen and L. Sproull, eds., Sage, London.

Bailey, K. (1982). Methods of social research, Free Press, New York.

Bandura, A. (1977). Social learning theory, Prentice Hall, Englewood, NJ.

Barley, S. (1990). "The alignment of technology and structure through roles and networks." Administrative Science Quarterly, 35(1), 61-103.

Barney, J. (1996). "The resource-based theory of the firm." Organization Science, 7(5), 469.

Barringer, M. and Milkovich, G. (1998). "A theoretical exploration of the adoption and design of flexible benefit plans: A case of human resource innovation." Academy of Management Review, 23(2), 305-324.

Bell, D. (1973). The coming of post-industrial society: A venture in social forecasting, Basic Books, New York.

Benbasat, I., Goldstein, D., and Mead, M. (1987). "The case research strategy in studies of information systems." MIS Quarterly, 11(3), 369-386.

Benne, K. and Sheats, P. (1948). "Functional roles of group members." Journal of Social Issues, 4(2), 41-49.

Berger, P. and Luckmann, T. (1967). The social construction of reality: A treatise in the sociology of knowledge, Anchor Books, New York.

Bijker, W., Hughes, T., and Pinch, T. (1987). "General introduction." The social construction of technology systems: New directions in the sociology of history and technology, W. Bijker, T. Hughes, and T. Pinch, eds., MIT, Cambridge, MA.

Birchall, D. and Tovstiga, G. (1999). "The strategic potential of a firm's knowledge portfolio." Journal of General Management, 25(1), 1-16.

Bishop, S. (1999). "Cross-functional project teams in functionally aligned organizations." Project Management Journal, 30(3), 6-12.

Black, J. A. and Champion Dean J. (1976). Methods and issues in social research, John Wiley & Sons, London.

Blackler, F. (1995). "Knowledge, knowledge work and organizations: An overview and interpretation." Organization Studies, 16(6), 1021-1046.

Blackler, F., Crump, N., and McDonald, S. (2000). "Organizing processes in complex activity network." Organization, 7(2), 277-300.

Blaikie, N. (1993). Approaches to social enquiry, Blackwell, Cambridge.

Blumer, H. (1969). Symbolic interactionism: Perspective and method, Prentice-Hall, London.

Bogdan, R. and Taylor, S. (1975). Introduction to qualitative research methods, John Wiley & Sons, Canada.

Boisot, M., Griffiths, D., and Moles, V. (1997). "The dilemma of competence: Differentiation versus integration in the pursuit of learning." Strategic learning and knowledge management, R. Sanchez and A. Heene, eds., John Wiley & Sons , Chichester.

Boisot, M. (1995). Information space: A framework for learning in organizations,

institutions and culture, Routledge, London.

Boisot, M. and Griffiths, D. (1999). "Possession is nine tenths of the law: Managing a firm's knowledge base in a regime of weak appropriability." International Journal of Technology Management, 17(6), 662-676.

Boland, R. and Tenkasi, R. (1995). "Perspective making and perspective taking in communities of knowing." Organization Science, 6(4), 350-372.

Bowen, K., Clark, K., Holloway, C., and Wheelwright, S. (1994). "Development projects: The engine of renewal." Harvard Business Review, 72(5), 110-120.

Boyce, M. (1995). "Collective centering and collective sense-making in the stories and storytelling of one organization." Organization Studies, 16(1), 107-137.

Bozdogan, K., Deyst, J., Hoult, D., and Lucas, M. (1998). "Architectural innovation in product development through early supplier integration." R&D Management, 28(3), 163-173.

Brand, A. (1998). "Knowledge Management and Innovation at 3M." Journal of Knowledge Management, 2(1), 17-22.

Brass, D. and Burkardt, M. (1993). "Potential power and power use: An investigation of structure." Academy of Management Journal, 36(4), 441-472.

Brown, J. (1991). "Research that reinvents the corporation." Harvard Business Review, 69(1), 102-111.

Brown, J. and Duguid, P. (1991). "Organisational learning and toward a unified view of working, learning and innovation." Organization Science, 2(1), 40-56.

Bryman, A. (1989). Research methods and organisational studies, Unwin Hyman, London.

Bryman, A. and Burgess, R. (1999). "Introduction: Qualitative research methodology- A review." Qualitative research volume I, A. Bryman and R. Burgess, eds., Sage,

London.

Burgelman, R. (1983). "A process model of internal corporate venturing in the diversified major firm." Administrative Science Quarterly, 28(2), 223-244.

Burgess, R. (1981). "Keeping a research diary." Cambridge Journal of Education, 11(1), 75-81.

Burgess, R. G. (1982). Field research: A sourcebook and field manual, Allen & Unwin, London.

Burt, R. (1992). Structural holes: The social structure of competition, Harvard University Press, Cambridge, MA.

Bush, D. and Dooley, K. (1992). "A learning process for transformation to continuous improvement management." Human Systems Management, 1(4), 181-192.

Bush, J. and Frohman, A. (1991). "Communication in a 'network' organization." Organizational Dynamics, 20(2), 23-36.

Calder, A. and Sheridan, D. (1984). Speak for yourself: a mass-observation anthology 1937-49, Jonathan Cape, London.

Cameron, K., Kim, M., and Whetten, D. (1987). "Organizational effects of decline and turbulence." Administrative Science Quarterly, 32(2), 222-240.

Campbell, N. (1985). "Sources of competitive rivalry in Japan." The Journal of Product Innovation Management, 2(4), 224-231.

Cannon-Bowers, J. and Converse, S. (1993). "Shared mental models in expert team decision making." Individual and group decision making: Current issues, J. Castellan Jr., eds., Lawrence Erlbaum Associates Inc., Publishers, New Jersey.

Capron, L., Dussauge, P., and Mitchell, W. (1998). "Resource redeployment following horizontal acquisitions in Europe and North America, 1988-1992." Strategic Management Journal, 19(7), 631-661.

Carley, K. (1992). "Organizational learning and personnel turnover." Organization Science, 3(1), 20-46.

Carlson, M. and Lundqvist, M. (1995). "Work with and implementation of new concepts for management of product development: Experiences for the Swedish manufacturing industry." R&D Management, 25(1), 45-56.

Case, R. and Shane, S. (1998). "Fostering risk taking in research and development: The importance of a project's terminal value." Decision Sciences, 29(4), 765-783.

Cespedes, F. (1996). "Beyond teamwork: How the wise can synchronize." Marketing Management, 5(1), 24-36.

Chang, C.-Y. and Chung, C.-G. (1994). "A knowledge-based operation support system for network traffic management." Decision Support Systems, 11(1), 25-36.

Chia, R. (1996). "Teaching paradigm shifting in management education: University business schools and the entrepreneurial imagination." The Journal of Management Studies, 33(4), 409-428.

Ciborra, C. and Patriotta, G. (1996). "Groupware and teamwork in new product development: The case of a consumer goods multinational." Groupware and teamwork, C. Ciborra, eds., John Wiley & Sons, Chichester.

Ciborra, C. and Suetens, N. (1996). "Groupware for an emerging virtual organisation." Groupware and teamwork, C. Ciborra, eds., John Wiley & Sons, Chichester.

Clark, J. and Guy, K. (1998). "Innovation and competitiveness: A review." Technology Analysis & Strategic Management, 10(3), 363-395.

Clark, K. and Fujimoto, T. (1991). Product development performance: Strategy, organisation, and management in the world auto industry, Harvard Business School Press, Boston.

Cochran, D. and Dolan, J. (1984). "Qualitative research: An alternative to quantitative

research in communication." The Journal of Business Communication, 21(4), 25-32.

Cohen, M. and Bacdayan, P. (1994). "Organizational routines are stored as procedural memory." Organization Science, 5(4), 554-568.

Cohen, M. and Levinthal, D. (1990). "Absorptive capacity: A new perspective on learning and innovation." Administrative Science Quarterly, 35(1), 128-152.

Cohen, M. and Sproull, L. (1996). Organizational learning, Sage, London.

Coleman, J. (1988). "Social capital in the creation of human capital." American Journal of Sociology, 94(1), 95-120.

Collins, H. (1993). "The structure of knowledge." Social Research, 60(1), 95-116.

Collins, H. and Pinch, T. (1982). Frames of meaning: The social construction of extraordinary science, Routledge, London.

Collins, R. (1981). "On the micro-foundations of macro-sociology." American Journal of Sociology, 86(6), 984-1014.

Combs, K. (1993). "The role of information sharing in cooperative research and development." International Journal of Industrial Organization, 11(4), 535-551.

Conger, J. (1998). "The necessary art of persuasion." Harvard Business Review, 76(3), 84-95.

Conner, K. and Prahalad, C. (1996). "A resource-based theory of the firm: Knowledge versus opportunism." Organization Science, 7(5), 477-501.

Cooper, R. (1988). "The new product process: A decision guide for management." Journal of Marketing Management, 3(2), 238-255.

Cooper, R. (1986). Winning at new products, Reading, Addison-Wesley.

Corner, J. (1991). "In search of more complete answers to research questions.

Qualitative versus quantitative research methods: is there a way forward?" Journal of Advanced Nursing, 16(6), 718-727.

Corner, J. and Wilson-Barnett, J. (1992). "The newly registered nurse and the cancer patient: An educational evaluation." International Journal of Nursing Studies, 29(2), 177-90.

Cowman, S. (1993). "Triangulation: A means of reconciliation in nursing research." Journal of Advanced Nursing, 18(5), 788-792.

Cox, T. (1991). "The multicultural organization." The Academy of Management Executive, 5(2), 34-47.

Cullen, J. (1998). "The needle and the damage done: Research, action research, and the organisational and social construction of health in the 'information society'." Human Relations, 51(12), 1543-1564.

Currer, C. (1992). "Strangers or sisters? An exploration of familiarity, strangeness, and power in research." Studies in qualitative methodology, R. Burgess, eds., JAI Press, London.

Cyert, R. M. and March, J. C. (1963). A behavioral theory of the firm, Blackwell Publishers Inc., Cambridge, Massachusetts.

Daft, R. and Weick, K. (1984). "Toward a model of organizations as interpretation systems." Academy of Management Review, 9(2), 284-295.

Das, T. (1983). "Qualitative research in organizational behavior." The Journal of Management Studies, 20(3), 301-314.

Davenport, T. and Prusak, L. (1998). Working knowledge: How organizations manage what they know, Harvard Business School Press, Boston.

Davenport, T. (1992). Process innovation: Reengineering through information technology, Harvard Business School Press, Boston.

Davidson, B., Roy, U., and Ludden, C. (1999). "An expert system for the design and analysis of composite structures." IIE Transactions, 31(4), 303-312.

Day, G. (1994). "The capabilities of market-driven organizations." Journal of Marketing, 58(4), 37-52.

De Meyer, A. (1998). "Manufacturing operations in Europe: Where do we go next?" European Management Journal, 16(3), 262-271.

Demsetz, H. (1991). "The theory of the firm revisited." The nature of the firm, O. Williamson and S. Winter, eds., Oxford University Press, Oxford.

Denison, D., Hart, S., and Kahn, J. (1996). "From chimneys to cross-functional teams: Developing and validating a diagnostic model." Academy of Management Journal, 39(4), 1005-1023.

Denzin, N. (1988). The research act, McGraw-Hill, New York.

Denzin, N. K. (1970). Sociological methods: A source-book, Aldine, Chicago.

Dingwall, R. (1997). "Accounts, interviews and observations." Context & methods in qualitative research, F. Miller and R. Dingwall, eds., SAGE, London.

Dodgson, M. (1993). "Organisational learning: A review of some literatures." Organization Studies, 14(3), 375-394.

Dosi, G. (1982). "Technical paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technological change." Research Policy, 11(3), 147-162.

Douherty, D. (1992). "A practice-centered model of organizational renewal through product innovation." Strategic Management Journal, 13(Special Issue), 77-92.

Drucker, P. (1968). The age of discontinuity: Guidelines to our changing society. Harper & Row, New York.

Drucker, P. (1999). "Knowledge-worker productivity: The biggest challenge." California Management Review, 41(2), 79-94.

Eales-White, R. (1992). "Managing change through changing behaviour." Industrial and Commercial Training, 24(1), 12-17.

Easterby-Smith, M., Thorpe, R., and Lowe, A. (1991). Management research: An introduction, Sage, London.

Eby, L. and Dobbins, G. (1997). "Collective orientation in teams: An individual and group-level of analysis." Journal of Organizational Behavior, 18(3), 275-295.

Eisenhardt, K. (1989). "Building theories from case study research." Academy of Management Review, 14(4), 532-550.

Elofson, G. and Konsynski, B. (1993). "Performing organizational learning with machine apprentices." Decision Support Systems, 10(2), 109-119.

Epple, D., Argote, L., and Devadas, R. (1996). "Organizational learning curves: A method for investigating intra-plant transfer of knowledge acquired through learning by doing." Organizational learning, M. Cohen and L. Sproull, eds., SAGE, London .

Epstein, M. and Roy, M.-J. (1997). "Using ISO for improved organizational learning and environmental management." Environmental Quarterly Management, 7(1), 21-30.

Everd, R. and Louis, M. R. (1981). "Alternative perspectives in the organizational sciences: "Inquiry from the inside" and "inquiry from the outside"." Academy of Management Review, 6(3), 385-395.

Fairweather, N. B. (1999). "Surveillance in employment: The case of teleworking." Journal of Business Ethics, 22(1), 39-49.

Fayol, H. (1949). General and industrial management, Pitman, London.

Feldman, M. and March, J. (1981). "Information in organization as signal and symbol." Administrative Science Quarterly, 26(2), 171-186.

Feldman, S. (1999). "The leveling of organizational culture: Egalitarianism in critical postmodern organization theory." The Journal of Applied Behavioral Science, 35(2), 228-244.

Fiol, C. M. and Lyles, M. A. (1985). "Organisational learning." Academy of Management Review, 10(4), 803-813.

Fiol, M. (1994). "Consensus, diversity, and learning in organizations." Organization Science, 5(3), 403-420.

Firestone, W. (1987). "Meaning n method: The rhetoric of quantitative and qualitative research." Educational Researcher, 16(7), 16-21.

Forsyth, D. (1990). Group dynamics, Brook/Cole, California.

Foss, N. (1996). "Knowledge-based approaches to the theory of the firm: Some critical comments." Organization Science, 7(5), 470-476.

Fulk, J. (1993). "Social construction of communication technology." Academy of Management Journal, 36(5), 921-950.

Gable, G. (1994). "Integrating case study and survey research methods: An example in information systems." European Journal of Information Systems, 3(2), 112-126.

Galbraith, J. (1994). Competing with flexible lateral organizations, Addison-Wesley, Reading.

Galbraith, J. (1977). Organizational design, Addison-Wesley, Reading, MA.

Galuni, D. and Rodan, S. (1998). "Resource recombination in the firm: Knowledge structures and the potential for Schumpeterian innovation." Strategic Management Journal, 19(12), 1193-1201.

Garfinkel, H. (1967). Studies in ethnomethodology, Prentice Hall, Englewood Cliffs, NJ.

Garvin, D. (1993). "Building a learning organisation." Harvard Business Review, 74(4), 78-91.

Geertz, C. (1973). "Thick description: Toward an interpretive theory of culture." The interpretation of cultures, C. Geertz, eds., Basic Books, New York.

Gergen, K. and Thatchenkery, T. (1996). "Organization Science as social construction: Postmodern potentials." Journal of Applied Behavioral Science, 32(4), 356-377.

Gherardi, S. (2000). "Practice-based theorizing on learning and knowing in organizations." Organization, 7(2), 211-224.

Giddens, A. (1984). The constitution of society: Outline of the theory of structure, Polity Press, Cambridge.

Giunipero, L. (1997). "Organizational change and survival skills for materiel managers." Hospital Materiel Management Quarterly, 18(3), 36-44.

Glaser, B. and Strauss, A. (1967). The discovery of grounded theory, Aidine, Chicago.

Glassman, R. (1973). "Persistence and loose coupling in living systems." Behavioral Science, 18(1), 83-98.

Glesne, C. and Peshkin, A. (1992). Becoming qualitative researcher: An introduction, Longman, New York.

Golden-Biddle, K. and Locke, K. (1997). Composing qualitative research, Sage, London.

Grandori, A. and Soda, G. (1995). "Inter-firm networks: Antecedents, mechanisms and forms." Organization Studies, 16(2), 183-214.

Grant, R. (1996). "Prospering in dynamically-competitive environment: Organizational capability as knowledge integration." Organization Science, 7(4), 375-387.

Grant, R. and Baden-Fuller, C. (1995). "A knowledge-based theory of inter-firm collaboration." Academy of Management Journal, Best Papers Proceedings, 17-21.

Greengard, S. (1994). "Making the virtual office a reality." Personnel Journal, 73(9), 66-71.

Greiner, R. and Metes, G. (1995). Going virtual: Moving your organisation into the 21st century, Prentice-Hall, New Jersey.

Gresov, C. and Drazin, R. (1997). "Equifinality: Functional equivalence in organization design." Academy of Management Review, 22(2), 403-428.

Griffin, R. and Kacmar, M. (1991). "Laboratory research in management: Misconceptions and missed opportunities." Journal of Organizational Behavior, 12(4), 301-311.

Grint, K. and Woolgar, S. (1997). The machine at work, Polity Press, Oxford.

Guba, E. and Lincoln, Y. (1981). Effective Evaluation, Jossey-Bass, London.

Gulick, L. and Urwick, L. (1937). Papers in the science of administration, Institute of Public Administration, Columbia University Press, New York.

Gummesson, E. (1991). Qualitative methods in management research, Sage, London.

Gunz, H. and Pearson, A. (1979). "How to manage control conflicts in project based organizations." Research Technology Management, 22(2), 23-29.

Guss, C. (1998). "Virtual project management: Tools and the trade." Project Management Journal, 29(1), 22-30.

Guzzo, R. and Jackson, M. (1996). "Teams in organizations: Recent research on performance and effectiveness." Annual Review of Psychology, 47(3), 307-388.

Habermas, J. (1987). Knowledge and human interests, Polity, Cambridge.

Hackbarth, G. and Grover, V. (1999). "The knowledge repository: Organizational memory information systems." Information Systems Management, 16(3), 21-30.

Hackman, J. (1990). Groups that work (and those that don't): Creating conditions for effective teamwork, Sage, California.

Haines, D. (1999). "Letting 'the system' do the work: The promise and perils of computerization." The Journal of Applied Behavioral Science, 35(3), 306-324.

Halfpenny, P. (1982). Positivism and sociology: Explaining social life, Allen and Unwin, London.

Hall, R. (1984). "The nature logic of management policy making: Its implications for the survival of an organisation." Management Science, 30(8), 905-927.

Handy, C. (1995). "Trust and the virtual organisation." Harvard Business Review, 73(3), 40-50.

Hansen, M. (1999). "The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits." Administrative Science Quarterly, 44(1), 82-111.

Hansen, M., Nohria, N., and Tierney, T. (1999). "What's your strategy for managing knowledge?" Harvard Business Review, 77(2), 106-116.

Hargadon, A. and Sutton, R. (1997). "Technology brokering and innovation in a product development firm." Administrative Science Quarterly, 42(4), 716-749.

Harmon, M. (1990). "Applied phenomenology and organization." Public Administrative Quarterly, 14(1), 10-17.

Harryson, S. (1997). "How Cannon and Sony drive product innovation through networking and application-focused R&D." The Journal of Product Innovation Management, 14(4), 288-295.

Hart, S., Boroush, M., Enk, G., and Hornick, W. (1985). "Managing complexity through

consensus mapping: Technology for structuring of group decisions." The Academy of Management Review, 10(3), 587-600.

Hatch, M. J. (1997). "Irony and the social construction of contradiction in the humor of a management team." Organization Science, 8(3), 275-288.

Hauptman, O. and Hirji, K. (1999). "Managing integration and coordination in cross-functional teams: An international study of concurrent engineering product development." R & D Management, 29(2), 179-191.

Hauser, M. (1998). "Organizational culture and innovativeness of firms- An integrative view." International Journal of Technology Development, 16(1-3), 239-255.

Haywood, M. (1998). Managing virtual teams: Practical techniques for high-technology project managers, Artech House, London.

Hedberg, B. (1982). "How organisations learn and unlearn." Handbook of organisation behavior, P. Nystrom and W. Starbuck, eds., Oxford University Press, New York.

Hedberg, B., Dahlgren, G., Hansson, J., and Olve, N.-G. (1994). Virtual Organizations and Beyond- Discover Imaginary Systems, John Wiley & Sons, Chichester.

Hedlund, G. (1994). "A model of knowledge management and the N-form corporation." Strategic Management Journal, 15(Summer Special Issue), 73-90.

Henderson, R. (1994). "Managing innovation in the information age." Harvard Business Review, 72(1), 100-115.

Henke, J., Krachenberg, R. and Lyons, T. (1993). "Perspective: Cross-functional teams: Good concept, poor implementation!" Journal of Product Innovation Management, 10(3), 216-229.

Hiebeler, R. (1996). "Benchmarking knowledge management." Strategy & Leadership, 22-29.

Holstein, J. and Gubrium, J. (1997). "Active interviewing." Qualitative research: Theory, method and practice, D. Silverman, eds., Sage, London.

Huber, G. (1991). "Organisational learning: The contributing processes and the literatures." Organization Science, 2(1), 88-115.

Hunt, S. and Benford, R. (1997). "Dramaturgy and methodology." Context & method in qualitative research, G. Miller and R. Dingwall, eds., Sage, London.

Hurst, D., Rush, J., and White, R. (1989). "Top management teams and organizational renewal." Strategic Management Journal, 10(Summer Special Issue), 87-105.

Husserl, E. and Husserl, E. (1970). Crisis of European sciences and transcendental phenomenology: An introduction to phenomenological philosophy, translated by D. Carr, Northwestern University Press, London.

Hutchins, E. (1991). "Organizing work by adaptation." Organization Science, 2(1), 14-39.

Hutt, M., Walker, B., and Frankwick, G. (1995). "Hurdle the cross-functional barriers to strategic change." Sloan Management Review, 36(3), 22-30.

Inkpen, A. (1998). "Learning and knowledge acquisition through international strategic alliances." Academy of Management Executive, 12(4), 69-80.

Ito, J. and Peterson, R. (1986). "Effects of task difficulty and interunit interdependence on information processing systems." Academy of Management Journal, 29(1), 139-149.

Janesick, V. (1994). "The dance of qualitative research design: Metaphor, methodology, and meaning." Handbook of qualitative research, N. Denzin and Y. Lincoln, eds., Sage, London.

Jantsch, E. (1980). The self-organizing universe: Scientific and human implications of the emerging paradigm of evolution, Pergamon, New York.

Jarratt, A. (1999). "Managing diversity and innovation in a complex organization." International Journal of Technology Management, 17(1), 5-15.

Jarvenpaa, S., Knoll, K. and Leidner, D. (1998). "Is anybody out there? The antecedents of trust in global virtual teams." Journal of Management Information Systems, 14(4), 29-64.

Jassawalla, A. and Sahittal, H. (1998). "An examination of collaboration in high-technology new product development processes." The Journal of Product Innovation Management, 15(3), 237-254.

Jelinek, M. and Goldhar, J. (1984). "The strategic implications of the factory of the future." Sloan Management Review, 25(4), 29-37.

Johnson, D. and Johnson, F. (1982). Joining together: Group theory and group skills, Prentice Hall, Englewood Cliffs.

Jones, A. and Hendry, C. (1994). The learning organisation: A review of literature and practice, University of Warwick, Coventry.

Jones, S. (1985). "The analysis of depth interviews." Applied qualitative research, R. Walker, eds., Gower, Hants.

Kanter, R. (1999). "Change is everyone's job: Managing the extended enterprise in a globally connected world." Organizational Dynamics, 28(1), 7-23.

Kasl, E., Marsick, V., and Dechant, K. (1997). "Teams as learners: A research-based model of team learning." The Journal of Applied Behavior Science, 33(2), 227.

Katz, J. (1983). "A theory of qualitative methodology: The social system of analytic fieldwork." Contemporary field research, R. Emerson, eds., Little Brown, Boston.

Katz, R. and Tushman, M. (1983). "A longitudinal study of the effects of boundary spanning supervision on turnover and promotion in research and development."

Academy of Management Journal, 26(3), 437-456

Katzenback, J. and Smith, D. (1995). "The discipline of teams." The product development challenge: Competing through speed, quality and creativity, K. Clark and S. Wheelwright, eds., Harvard Business School Publishing, Boston.

Kessler, E. and Chakrabarti, A. (1996). "Innovation speed: A conceptual model of context, antecedents, and outcomes." The Academy of Management Review, 21(4), 1143-1191.

Kiesler, S. and Sproull, L. (1982). "Managerial response to changing environments: Perspectives on problem sensing from social cognition." Administrative Science Quarterly, 27(4), 548-570.

Kim, C. and Mauborgne, R. (1999). "Strategy, value innovation, and the knowledge economy." Sloan Management Review, 40(3), 41-54.

Kirk, J. and Miller, M. L. (1986). Reliability and validity in qualitative research, Sage, Beverly Hills.

Kish, L. (1987). Statistical design for research, Wiley, London.

Kitzinger, J. (1994). "The methodology of focus groups: The importance of interaction between research participants." Sociology of Health and Illness, 16(1), 103-121.

Klien, H. and Myers, M. (1999). "A set of principles for conducting and evaluating interpretive filed studies in information systems." MIS Quarterly, 23(1), 67-94.

Kogut, B. and Zander, U. (1992). "Knowledge of the firm, combinative capabilities, and the replication of technology." Organization Science, 3(3), 383-397.

Kolb, D. (1984). Experiential learning, Prentice-Hall, New Jersey.

Kolb, D. and Fry, R. (1975). "Towards an applied theory of experiential learning." Theories of group processes, C. Cooper, eds., John Wiley & Sons, London.

Krauss, R. and Fussell, S. (1991). "Perspective-taking in communication representation of other's knowledge in reference." Social Cognition, 9(1), 2-24.

Kreiner, K. and Schultz, M. (1993). "Informal collaboration in R&D: The formation of networks across organizations." Organization Studies, 14(2), 189-209.

Kuhn, T. (1970). The structure of scientific revolutions, The University of Chicago Press, Chicago.

Kumar, R. and Nti, K. (1998). "Differential learning and interaction in alliance dynamics: A process and outcome discrepancy model." Organization Science, 9(3), 356-367.

Lam, A. (1997). "Embedded firms, embedded knowledge: Problems of collaboration and knowledge transfer in global cooperative ventures." Organization Studies, 18(6), 973-996.

Lane, P. and Lubatkin, M. (1998). "Relative absorptive capacity and interorganizational learning." Strategic Management Journal, 19(5), 461-477.

Larsson, R., Eneroth, K., and Konig, I. (1996). "On the folly of rewarding domestic stability while hoping for international expansion." International Studies of Management & Organization, 26(1), 105-133.

Latour, B. (1987). Science in action: How to follow scientists and engineers through society, Open University Press, Milton Keynes.

Lave, J. and Wenger, E. (1991). Situated learning: Legitimate peripheral participation, Cambridge University Press, Cambridge.

Lawrence, P. and Lorsch, J. (1967). Organisation and Environment: Managing differentiation and integration, Harvard University Press, Boston.

Lazega, E. (1992). Micropolitics of knowledge: Communication and indirect control in workgroups, Aldine De Gruyter, New York.

Lee, A. (1989). "A scientific methodology for MIS case studies." MIS Quarterly, 13(1), 33-52.

Lemaitre, N. and Steiner, B. (1988). "Stimulating innovation in large companies." R&D Management, 18(2), 141-158.

Lembke, S. and Wilson, M. (1998). "Putting the "team" into teamwork: Alternative theoretical contributions for contemporary management practice." Human Relations, 51(7), 927-944.

Leonard-Barton, D. (1992). "Core capabilities and core rigidities: A paradox in managing new product development." Strategic Management Journal, 13(Summer Special Issue), 111-125.

Levitt, B. and March, J. (1988). "Organisational learning." Annual Review of Sociology, 14 (3), 319-340.

Lichtenstein, R., Alexander, J., Jinnett, K., and Ullman, E. (1997). "Embedded intergroup relations in interdisciplinary teams: Effects on perceptions of level of team integration." Journal of Applied Behavioral Science, 33(4), 413-434.

Linnehan, F. and Konrad, A. (1999). "Diluting diversity: Implications for intergroup inequality in organizations." Journal of Management Inquiry, 8(4), 399-414.

Lipnack, J. and Stamps, J. (1997). Virtual Learning: Reaching across space, time, and organizations with technology, John Wiley & Sons, Chichester.

Lukes, S. (1974). Power: A radical view, Macmillian, London.

Luthans, F. and Davis, T. (1982). "An idiographic approach to organizational behavior research: The use of single case experimental designs and direct measures." Academy of Management Review, 7(3), 380-391.

Lvinthal, D. and March, J. (1981). "A model of adaptive organizational search." Journal of Economic Behavior and Organizations, 2(2), 307-333.

Lyles, M. (1988). "Learning among joint venture sophisticated firms." Management International Review, 28(Special Issue), 85-98.

Lynch, T. and Lynch, C. (1996). "Twenty-first century budget reform: Performance, entrepreneurial, and competitive budgeting." Public Administration Quarterly, 20(3), 255-284.

Maani, K. and Benton, C. (1999). "Rapid Team learning: Lessons from teams New Zealand America's Cup campaign." Organizational Dynamics, 27(4), 48-62.

Madhavan, R. and Grover, R. (1998). "From embedded knowledge to embodied knowledge: New product development as knowledge management." Journal of Marketing, 62(4), 1-12.

Magjuka, R. and Baldwin, T. (1991). "Team-based employee involvement programs: Effects of design and administration." Personnel Psychology, 44(4), 793-812.

Mamaghani, F. (1999). "Information systems project evaluation and selection: An application study." International Journal of Management, 16(1), 130-138.

March, J. (1991). "Exploration and exploitation in organizational learning." Organization Science, 2(1), 71-86.

March, J., Sproull, L., and Tamuz Michal (1991). "Learning from Samples of One or Fewer." Organization Science, 2(1), 1-13.

Marsick, V. and Watkins, K. (1997). "Lessons from informal and incidental learning." Management learning: Integrating perspectives in theory and practice, J. Burgoyne and M. Reynolds, eds., Sage, London.

Martin, P. and Turner, B. (1986). "Grounded theory and organizational research." The Journal of Applied Behavioral Science, 22(2), 141-157.

Martiny, M. (1998). "Knowledge management at HP Consulting." Organizational Dynamics, 26 (2) 71-77.

Matusik, S. and Hill, C. (1998). "The utilization of contingent work, knowledge creation, and competitive advantage." Academy of Management Review, 23(4), 680-697.

Maxim, P. (1999). Quantitative research methods in the social sciences, Oxford University Press, Oxford.

McBain, R. and Kusy, M. (1997). "On team effectiveness, team learning and learning in organizations." Manager Update, 9(2), 20-31.

McGill, M. and Slocum Jr., J. (1993). "Unlearning the organization." Organizational Dynamics, 22(2), 67-79.

McGinnis, M. and Ackelsberg, R. (1983). "Effective innovation management: Missing link in strategic planning? " The Journal of Business Strategy, 4(1), 59-66.

McGrath, J. (1984). Groups, interaction and performance, Prentice-Hall, New Jersey.

McKenna, S. (1992). "A culture instrument: Driving organizational learning." Leadership & Organization Development Journal, 13(6), 24-29.

McLeod, P. and Lobel, S. (1992). "The effects of ethnic diversity on idea generation in small groups." Academy of Management Best Paper Proceedings, 227-231.

McLoughlin, I. (1999). Creative technological change: The shaping of technology and organisations, Routledge, London.

Mead, G. (1934). The social psychology of George Herbert Mead, University of Chicago, Chicago.

Meyers, P. and Wilemon, D. (1989). "Learning in new technology development teams." The Journal of Product Innovation Management, 6(2), 79-88.

Miles, M. B. and Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook, Sage, London.

Miles, R. and Randolph, W. (1980). "Influence of organizational learning styles on early development." The organizational life cycle, J. Kimberly and R. Miles, eds., Jossey-Bass, San Francisco.

Miles, R. and Snow, C. (1986). "Organisations: new concepts for new forms." California Management Review, 28(3), 62-73.

Miller, C. C., Cardinal, L., and Glick, W. (1997). "Retrospective reports in organizational research: A reexamination of recent evidence." Academy of Management Journal, 40(1), 189-204.

Miner, A. and Mezias, S. (1996). "Ugly duckling no more: Pasts and futures of organisational learning research." Organization Science, 7(1), 88-99.

Misztal, B. (1996). Trust in modern societies, Blackwell, Oxford.

Mitchell, J. C. (1983). "Case and situation analysis." Sociological Review, 31(2), 186-211.

Moenaert, R. and Souder, W. (1990). "An information transfer model for integrating marketing and R&D personnel in new product development projects." Journal of Product Innovation Management, 7(2), 91-107.

Mooney, J. D. (1947). The principles of organization, Harper & Row, London.

Moorman, C. and Miner, A. (1997). "The impact of organizational memory on new product performance and creativity." Journal of Marketing Research, 34(1), 91-106.

Moorman, C. and Miner, A. (1998). "Organizational improvisation and organizational memory." Academy of Management Review, 23(4), 698-723.

Morgan, G. (1997). Image of organization, Sage, London.

Mueller, F. (1996). "Human resources as strategic assets: A resource-based evolutionary theory." Journal of Management Studies, 33(6), 757-785.

Mueller, F. and Dyerson, R. (1999). "Expert humans or expert organizations?" Organization Studies, 20(2), 225-256.

Mullin, R. (1996). "Knowledge management in cultural evolution." Journal of Business Strategy, 17(5), 56-59.

Nadel, S. (1957). A theory of social structure, Cohen and West, London.

Nadler, D. (1981). "Managing organizational change: An integrative perspective." The Journal of Applied Behavioural Science, 17(2), 191-211.

Nahapiet, J. and Ghoshal, S. (1998). "Social capital, intellectual capital, and the organizational advantage." Academy of Management Review, 23(2), 242-266.

Nambisan, S., Agarwal, R., and Tanniru, M. (1999). "Organizational mechanisms for enhancing user innovation in information technology." MIS Quarterly, 23(3), 365-395.

Nemetz, P. and Christensen, S. (1996). "The challenge of cultural diversity: Harnessing a diversity of view to understand multiculturalism." Academy of Management Review, 21(2), 434-462.

Neumann, F. (1997). "Organizational structures to match the new information-rich environments: Lessons from the study of chaos." Public Productivity & Management Review, 21(1), 86-100.

Newell, A. and Simon, H. (1972). Human problem solving, Prentice Hall, Englewood Cliff, NJ.

Newell, S. and Swan, J. (2000). "Trust and inter-organisational networking." Human Relations, forthcoming.

Nicolini, D. and Meznar, M. (1995). "The social construction of organisational learning: Conceptual and practical issues in the field." Human Relations, 48(7), 727-746.

Nissen, M. (1999). "Knowledge-based knowledge management in the reengineering

domain." Decision Support System, 27(1), 47-65.

Nkomo, S. (1987). "Human resource planning and organization performance: An exploratory analysis." Strategic Management Journal, 8(4), 387-392.

Noble, C. (1999). "Building the strategy implementation network." Business Horizons, 42(6), 19-28.

Nohria, N. and Eccles, R. (1992). "Face-to-face: Making network organizations work." Networks and organizations: Structure, form and action, N. Nohria and R. Eccles, eds., Harvard Business School Press, Boston, 288-308.

Nonaka, I. (1994). "A dynamic theory of organizational knowledge creation." Organization Science, 5(1), 14-37.

Nonaka, I. (1990). "Redundant, overlapping organization: A Japanese approach to managing the innovation process." California Management Review, 32(3), 27-38.

Nonaka, I. and Konno, N. (1998). "The concept of 'Ba'": Building a foundation for knowledge creation." California Management Review, 40(3), 40-54.

Nonaka, I. and Takeuchi, H. (1995). The knowledge-creating company, how Japanese companies create the dynamics of innovation, Oxford University Press, Oxford.

Nystrom, P. and Starbuck, W. (1984). "To avoid organizational crises, unlearn." Organizational Dynamics, 12(4), 53-65.

O'Dell, C. and Grayson, C. (1998). "If only we knew what we know: Identification and transfer of internal best practices." California Management Review, 40(3), 154-174.

Orlikowski, W. (1993). "CASE tools as organizational change: Investigating incremental and radical changes in systems development." MIS Quarterly, 17(3), 309-340.

Orlikowski, W. and Baroudi, J. (1991). "Studying in formation technology in

organizations: Research approaches and assumptions." Information Systems Research, 2(1), 1-28.

Orr, J. (1990). "Sharing knowledge, celebrating identity: War stories and community memory in a service culture." Collective remembering: Memory in society, D. Middleton and D. Edwards, eds., SAGE, Beverly Hills, CA.

Orton, J. D. and Weick, K. (1990). "Loosely coupled systems: A reconceptualization." Academy of Management Review, 15(2), 203-223.

Ouchi, W. (1981). Theory Z: How American business can meet the Japanese challenge, Addison-Wesley, Reading.

Pan, S. L. and Scarbrough, H. (1999). "Knowledge management in practice: An exploratory case study." Technology Analysis & Strategic Management, 11(3), 359-374.

Patton, M. (1990). Qualitative evaluation and research methods, Sage, London.

Pavitt, K. (1991). "Key Characteristics of the Large Innovating Firm." British Journal of Management, 2(1), 41-50.

Payne, S. (1997). "Nursing research: A social science? " Understanding social research: Perspectives on methodology and practice, G. McKenzie, J. Powell and R. Usher, eds., The Falmer Press, London.

Pedler, M., Burgoyne, J., and Boydell, T. (1991). The learning company: A strategy for sustainable development, McGraw-Hill, Maidenhead.

Penrose, E. (1959). The theory of the growth of the firm, Wiley, London.

Pettigrew, A. (1992). "The character and significance of strategy process research." Strategic Management Journal, 13(Special Issue), 5-16.

Pfeffer, J. (1981). Power in organizations, Pitman, Marshfield, MA.

Pfeffer, J. and Salancik, G. (1978). The external control of organizations: A resource dependence perspective, Harper & Row, New York.

Phillips, D. (1987). Philosophy, science and social inquiry, Pergamon Press, Oxford.

Phillips, E. and Push, D. (1987). How to get a PhD, Open University Press, Milton Keynes.

Pinch, T. and Bijker, W. (1987). "The social construction of facts and artifacts: or how the sociology of science and the sociology of technology might benefit each other." The social construction of technological systems: New directions in the sociology of history and technology, W. Bijker, T. Hughes, and T. Pinch, eds., MIT Press, Cambridge, MA.

Pinto, M. B. and Pinto, J. (1990). "Project team communication and cross-functional cooperation in new program development." Journal of Product Innovation Management, 7(3), 200-212.

Pisano, G. (1994). "Knowledge, integration, and the locus of learning: An empirical analysis of process development." Strategic Management Journal, 15(Winter Special Issue), 85-100.

Platt, J. (1988). "What can case studies do? " Studies in qualitative methodology, volume 1, R. Burgess, eds., JAI Press, London.

Polanyi, M. (1958). Personal knowledge, University of Chicago Press, Chicago.

Polkinghorne, D. (1992). "Post-modern epistemology of practice." Psychology and postmodernism, S. Kvale, eds., Sage, London.

Poole, M. and Van De Ven, A. (1989). "Using paradox to build management and organization theories." Academy of Management Review, 14(4), 562-578.

Powell, J. (1997). "Researching social work and social care practices." Understanding social research: Perspectives on methodology and practice, G. McKenzie and J.

Powell and R. Usher, eds., The Falmer Press, London.

Powney, J. and Watts, M. (1987). Interviewing in educational research, Routledge & Kegan Paul, London.

Prahalad, C. and Hamel, G. (1990). "The core competence of the corporation." Harvard Business Review, 68(3), 79-91.

Quinn, J., Anderson, P. and Finkelstein, S. (1996). "Managing professional intellect making the most of the best." Harvard Business Review, 74(2), 71-80.

Quintas, P., Lefrere, P. and Jones, G. (1997) "Knowledge management: A strategic agenda." Long Range Planning, 30(3), 385-391.

Ramesh, B. and Tiwana, A. (1999). "Supporting collaborative process knowledge management in new product development teams." Decision Support Systems, 27(2), 213-235.

Rebentisch, E. and Ferretti, M. (1995). "A knowledge asset-based view of technology transfer in international joint ventures." Journal of Engineering and Technology Management, 12(1), 1-24.

Reed, R., Lemak, D., and Hesser, W. A. (1997). "Cleaning up after the cold war: Management and social issues." Academy of Management Review, 22(3), 614-642.

Reichers, A. (1987). "An interactionist perspective on newcomer socialization rates." Academy of Management Review, 12(2), 278-287.

Ring, P. and Van de Ven, A. (1994). "Developmental processes of cooperative interorganizational relationships." Academy of Management Review, 19(1), 90-118.

Robson, C. (1993). Real world research: A resource for social scientists and practitioner-researchers, Blackwell, Oxford.

Rochford, L. and Rudelius, W. (1992). "How involving more functional areas within a firm affects the new product process." The Journal of Product Innovation Management, 9(4), 287-299.

Roos, J., Roos, G., Edvinsson, L., and Diago, N. (1997). Intellectual capital- Navigating in the business landscape, Macmillan Press Ltd., London.

Roth, G. and Kleiner, A. (1998). "Developing organizational memory through learning histories." Organizational Dynamics, 27(2), 43-60.

Sackmann, S. (1991). Cultural knowledge in organisations: Exploring the collective mind, Sage, London.

Sackmann, S. (1992). "Culture and subcultures: An analysis of organizational knowledge." Administrative Science Quarterly, 37(1), 140-161.

Sahay, S. and Palit, M. (1994) "A relativist approach to studying the social construction of information technology." European Journal of Information Systems, 3(4), 248-258.

Sanchez, R. and Heene, A. (1997). "A competence perspective on strategic learning and knowledge management." Strategic learning and knowledge management, R. Sanchez and A. Heene, eds., Sage, Chichester.

Sandelands, L. and Stablein, R. (1987). "The concept of organization mind." Research in the sociology of organizations, S. Bachrach and N. DiTomaso, eds., JAI Press, Greenwich.

Satzinger, J., Garfield, M., and Nagasundaram, M. (1999). "The creative process: The effects of group memory on individual idea generation." Journal of Management Information Systems, 15(4), 143-160.

Savage, M. (1990). 5th generation management, Digital Press, Bedford, MA.

Scarbrough, H. (1996). "Strategic change in financial services: The social construction

of strategic IS." Information technology and change in organizational work, W. Orlikowski, G. Walsham, M. Jones and J. DeGross, eds., Chapman & Hall, London, 197-212.

Schein, E. (1996). "Culture: The missing concept in organization studies." Administrative Science Quarterly, 41(2), 229-240.

Schwab, R. (1985). "Redefining the boundary spanning-environment relationship." Journal of Management, 11(1), 75-86

Scott, D. (1997). "Qualitative approaches to data collection and analysis." Understanding social research: Perspectives on methodology and practice, G. McKenzie, J. Powell and R. Usher, eds., The Falmer Press, London.

Scott, J. (1992). Social network analysis: A handbook, Sage, London.

Seibert, K. (1999). "Reflection-in-action: Tools for cultivating on-the-job learning conditions." Organizational Dynamics, 27(3), 54-65.

Senge, P. (1990). "The leader's new work: Building learning organisations." Sloan Management Review, 32(1), 7-23.

Senge, P. M. (1990). The fifth discipline, the art and practice of the learning organisation, Century Business, London.

Sessa, V. (1996). "Using perspective taking to manage conflict and affect in terms." The Journal of Applied Behavioral Science, 32(1), 101-115.

Shaw, J. and Barrett-Power, E. (1998). "The effects of diversity on small work group processes and performance." Human Relations, 51(10), 1307-1325.

Sheptycki, J. (1998). "The global cops cometh: Reflections on transnationalization, knowledge work and policing subculture." The British Journal of Society, 49(1), 57-74.

Shrivastava, P. and Schneider, S. (1984). "Organizatioanl frames of reference." Human

Relations, 37(4), 795-809.

Shrivastava, P. (1983). "A typology of organisational learning systems." Journal of Management Studies, 20(1), 7-28.

Silverman, D. (1998). "Analysing conversation." Research society and culture, C. Seale, eds., Sage, London.

Silverman, D. (1997). "The logics of qualitative research." Context & method in qualitative research, G. Miller and R. Dingwall, eds., Sage, London.

Simon, H. (1991). "Bounded rationality and organisational learning." Organization Science, 2(1), 125-133.

Skinner, S. (1953). Science and human behavior, MacMillan, New York.

Slonina, J. Jr. (1996). "The top 10 reasons for integrated enterprise management." Hospital Material Management Quarterly, 18(2), 1-8.

Smircich, L. (1983). "Concepts of culture and organizational analysis." Administrative Science Quarterly, 28(3), 339-358.

Smith, H. W. (1975). Strategies of social research: The methodological imagination, Prentice-Hall, London.

Smith, K. and Berg, D. (1987). Paradoxes of group life: Understanding conflict, paralysis, and movement in group dynamics, Jossey-Bass, San Francisco.

Smith, T. M. (1983). "On the validity of inferences from non-random samples." Journal of the Royal Statistical Society, 146(1), 131-149.

Snow, C. and Thomas, J. (1994). "Field research methods in strategic management: Contributions to theory building and testing." Journal of Management Studies, 31(4), 457-80.

Solomon, C. (1998). "Sharing information across borders and time zones." Workforce,

3(2), 12-18.

Souder, W. (1987). Managing new product innovation, Lexington Books, Lexington.

Souder, W. (1988). "Managing relations between R&D and marketing in new product development projects." Journal of Product Innovation Management, 5(1), 6-19.

Souder, W., Sherman, J. and Davies-Cooper, R. (1998). "Environmental uncertainty, organisational integration, and new product development effectiveness: A test of contingency theory." The Journal of Product Innovation Management, 15(6), 520-533.

Sparrow, J. (1998). Knowledge in organizations: Access to thinking at work, Sage, London.

Spender, J. and Grinyer, P. (1996). "Organizational renewal: Deinstitutionalization and loosely coupled systems." International Studies of Management and Organization, 26(1), 17-40.

Spender, J. C. (1996). "Making knowledge the basis of a dynamic theory of the firm." Strategic Management Journal, 16 (Winter Special Issue), 45-62.

Stake, R. (1995). The Art of Case Study Research, Sage, London.

Stanley, L. (1993). "On auto/biography in sociology." Sociology, 27(1), 41-52.

Star, S. (1989). "The structure of ill-structured solutions." Distributed artificial intelligence, L. Gasser and M. Huhns, eds., Morgan Kaufmann, San Mateo.

Starbuck, W. (1992). "Learning by knowledge intensive firms." Journal of Management Studies, 29(6), 713-740.

Steensma, H. and Tetteroo, A. (2000). "Attitudes toward cross-functional quality project groups: Net utility and procedural justice." Total Quality Management, 11(1), 123-128.

Stein, E. and Zwass, V. (1995). "Actualizing organizational memory with information systems." Information Systems Research, 6(2), 85-117.

Stevens, M. and Campion, M. (1994). "The knowledge, skill, and ability requirements for teamwork: Implications for human resource management." Journal of Management, 20(2), 503-530.

Steward, T. (1989). Intellectual capital: The new wealth of organisations, Macmillan Press, London.

Stigler, G. (1961). "The economics of information." Journal of Political Economy, 69(2), 213-225.

Strauss, A. and Corbin, J. (1990). Basics of qualitative research: Grounded theory procedures and techniques, Sage, London.

Swan, J., Newell, S. and Robertson, M. (1999). "Central agencies in the diffusion and design of technology: A comparison of the UK and Sweden." Organization Studies, 20(6), 905-932.

Szulanski, G. (1996). "Exploring internal stickiness: Impediments to the transfer of best practice within the firm." Strategic Management Journal, 17(winter special edition), 27-43.

Tajfel, H. and Turner, J. (1985). "The social identity theory of intergroup behavior." Psychology of intergroup relations, S. Worchel and W. Austin, eds., Nelson-Hall, Chicago.

Taylor, P. and Lowe, J. (1997). "Are functional assets or knowledge assets the basis of new product development performance?" Technology Analysis & Strategic Management, 9(4), 473-488.

Taylor, S. and Bogdan, R. (1984). Introduction to Qualitative Research Methods, John Wiley & Sons, Chichester.

Teece, D., Pisano, G., and Shuen, A. (1997). "Dynamic capabilities and strategic management." Strategic Management Journal, 18(7), 509-533.

Tenkasi, R. and Boland, R. Jr. (1996). "Exploring knowledge diversity in knowledge intensive firms: A new role for information systems." Journal of Organizational Change Management, 9(1), 79-91.

Teo, T., Lim, C. and Wai, S. (1998). "An empirical study of attitudes towards teleworking among information technology (IT) personnel." International Journal of Information Management, 18(5), 329-343.

Thompson, J. (1967). Organizations in action, McGraw-Hill, New York.

Thompson, S. (1992). Sampling, Wiley, London.

Tippett, D. and Peters, J. (1995). "Team building and project management: How are we doing? " Project Management Journal, 26(4), 29-37.

Todd, D. (1979). "Mixing qualitative and quantitative methods: Triangulation in action." Administrative Science Quarterly, 24(December), 602-11.

Toffler, A. (1990). Powershift: Knowledge, wealth and violence at the edge of 21st century, Bantam, New York.

Toffler, A. (1982). The third wave, Bantam, New York.

Townsend, A., DeMarie, S., and Hendrickson, A. (1998). "Virtual teams: Technology and the workplace of the future." Academy of Management Executive, 12(3), 17-29.

Trist, E. (1977). "Collaboration theory and organisations." Journal of Applied Behavioral Science, 13, 268-278.

Tsoukas, H. (1994). "Refining common sense: Types of knowledge in management studies." Journal of Management Studies, 31(6), 761-780.

Turner, B. (1983). "The use of grounded theory for the qualitative analysis of organizational behavior." The Journal of Management Studies, 20(3), 333-348.

Turner, R. and Keegan, A. (1999). "The versatile project-based organization: Governance and operational control." European Management Journal, 17(3), 296-309.

Tushman, M. and Nadler, D. (1978). "Information processing as an integrating concept in organization design." Academy of Management Review, 3(3), 613-624.

Tushman, M. and Nadler, D. (1986). "Organizing for innovation." California Management Review, 28(3), 74-92.

Tushman, M. and Scanlan, T. (1981). "Boundary spanning individuals: Their role in information transfer and their antecedents." Academy of Management Journal, 24(2), 289-305.

Vadlamani, B. (1997). "An integrative framework for R&D management in system industries." International Journal of Technology Management, 13(7), 818-832.

Van De Ven, A., Delbecq, A. and Koenig, R. (1976). "Determinants of coordination modes within organisations." American Sociological Review, 41(4), 522-542.

Van Maanen, J. (1979). "Reclaiming qualitative methods for organizational research." Administrative Science Quarterly, 24(4), 520-526.

Von Bertalanffy, L. (1972). General system theory: Foundations, development, applications, Allen Lane, London.

Von Hippel, E. (1988). The sources of innovation, Oxford University Press, Oxford.

Von Hippel, E. (1994). ""Sticky information" and the locus of problem solving: Implications for innovation." Management Science, 40(4), 429-439.

Von Krogh, G. (1998). "Care in knowledge creation." California Management Review, 40(3), 133-153.

Walsh, J. and Ungson, G. (1991). "Organisational memory." Academy of Management Review, 16(1), 57-91.

Walz, D., Elam, J., and Curtis, B. (1993). "Inside a software design team: Knowledge acquisition, sharing, and integration." Communications of the ACM, 36(10), 62-77.

Wang, S. (1999). "Organizational memory information systems: A domain analysis in the object-oriented paradigm." Information Resources Management Journal, 12(2), 26-35.

Warkentin, M., Sayeed, L., and Hightower, R. (1997). "Virtual teams versus face-to-face teams: An exploratory study of a Web-based conference system." Decision Sciences, 28(4), 975-996.

Wasserman, S. and Faust, K. (1994). Social network analysis: Methods and applications, Cambridge University Press, Cambridge.

Wathne, K., Roos, J., and von Krogh, G. (1996). "Towards a theory of knowledge transfer in a cooperative context." Managing knowledge- Perspectives on cooperation and competition, G. von Krogh and J. Roos, eds., Sage, London.

Weick, K. (1976). "Educational organizations as loosely coupled systems." Administrative Science Quarterly, 21(1), 1-19.

Weick, K. (1991). "The nontraditional quality of organisational learning." Organization Science, 2(1), 116-123.

Weick, K. (1979). The social psychology of organizing, Addison-Wesley, Reading.

Weick, K. (1989). "Theory construction as disciplined imagination." Academy of Management Review, 14(4), 516-531.

Weick, K. and Roberts, K. (1996). "Collective mind in organizations: Heedful interrelating on flight decks." Organizational learning, M. Cohen and L. Sproull,

eds., Sage, London.

Weiser, M. and Morrison, J. (1998). "Project memory: Information management for project teams." Journal of Management Information Systems, 14(4), 149-166.

Wenger, E. (2000). "Communities of practice and social learning systems." Organization, 7(2), 225-246.

Wenger, E. and Snyder, W. (2000). "Communities of practice: The organizational frontier." Harvard Business Review, 78(1), 139-145.

Wernerfelt, B. (1984). "A resource-based view of the firm." Strategic Management Journal, 5(2), 171-180.

Wheelan, S. (1994). Group Processes, Allyn and Bacon, London.

Wheelwright, S. (1985). "Restoring the competitive edge in U.S. manufacturing." California Management Review, 27(3), 26-42.

Wheelwright, S. and Clark, K. (1992). Revolutionizing product development: Quantum leaps in speed, efficiency and quality, The Free Press, New York.

Wheelwright, S. and Clark, K. (1994). The product development challenge: competing through speed, quality, and creativity, Harvard Business School Publishing, Boston.

Wilson, S. (1994). "The Virtual Office at Work." Human Resources, Autumn, 115-118.

Wissema, J., Brand, A., and Van Der Pol, H. (1981). "The incorporation of management development in strategic management." Strategic Management Journal, 2(4), 361-377.

Woolgar, S. (1991). "The turn to technology in social studies of science." Science, Technology and Human Values, 16(1), 20-50.

Yan, A. and Louis, M. (1999). "The migration of organizational functions to the work

unit level: Buffering, spanning, and bringing up boundaries." Human Relations, 52(1), 25-47.

Yelle, L. (1979). "The learning curve: Historical review and comprehensive survey." Decision Science, 10(3), 302-328.

Yin, R. (1984). Case study research: Design and methods, Sage, London.

Zack, M. (1999). "Managing codified knowledge." Sloan Management Review, 40(4), 45-58.

Zairi, M. and Letza, S. (1994). "Performance measurement: A challenge for total quality an the accounting professions." Asia Pacific Journal of Quality Management, 3(2), 26-41.

Zeller, R. (1980). Measurement in the social sciences: The link between theory and data, Cambridge University Press, Cambridge.